THE

ELECTRICAL REVIEW.

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THE

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THE LIVET DESTRUCTOR.

ADMISSIONS of errors in the published accounts of this now famed furnace, even though the fame be that of Eratostratus, are gradually, but unwillingly, being dragged forth.

While the ELECTRICAL REVIEW was the first to definitely state the true character of the destructor, it is gratifying to see that our contemporaries, *Engineering* and *Industries and Iron* are about equally outspoken, and we are glad to see that the former hammers away on the anvil of more information. Now it publishes a letter from Mr. F. H. Cheesewright, who thanks them for the attention they have given to the Livet inventions, and "*may I ask you to read for* 16,000, 1,600?" Our contemporary adds, "We presume we are now to understand that a Livet boiler installation" . . . "of 1,600 I.H.P. when burning refuse will cost £25,000," and very justly complains that the figure 16,000 has been in evidence since March 24th in a letter to the *Pall Mall Gazette*, but is only now tardily corrected. Now is not this a very remarkable thing, and what are we to think of steam boilers costing £15 12s. 6d. per I.H.P.? Taking a fairly large power as in, say, a standard cotton spinning mill, and two or three boilers at £500 each, will give 1,000 I.H.P., the cost per horse-power being from 20 to 30 shillings. Multiply this by five for equalising the poverty of the refuse with good coal, and we still only obtain a rate of £5 to £7 10s. per I.H.P. But it is just at this point that the weakness of the destructor comes in. If the refuse is three, four, or five times the inferior of coal, it is not in boiler capacity that equalisation must be sought, but in furnace capacity, and this cannot be done with internally fired boilers, for the diameter of the furnace tube is the controlling element. Unless, therefore, the cost per horse-power is to be increased in the ratio of the fuel inferiority, the internally fired boiler must be abandoned, for the cost is prohibitive. This brings us round again to what we said last week that something of the nature of a Juckes furnace or an external refractory furnace must be employed. Not content with pointing out the above grievous delay in setting right so gross an error, our contemporary further asks, regarding the hundreds of steam users claimed by Mr. Cheesewright as using boilers set on the Livet system, "Are these set on a system covered by any patent still in force?" This is a very pointed question indeed, the answer to which we look for with interest, for when we first encountered the Livet system in the year 1882, or early in 1883, we are inclined to think the Livet setting was then of some age. Anyhow, there cannot be, even if the patent were then brand new, very much left of 14 years. We do, however, distinctly remember that practical men at that time scouted the idea of any value attaching to the system, beyond that of enforcing flues of

good capacity—a quality then long insisted upon by the various boiler insurance companies, and in which there are no saleable rights.

Writing to *Industries*, Mr. Robert McGlasson is satisfied that Mr. Nursey would not, "from a scientific point of view," whatever that may mean, express his satisfaction with a boiler test (for such a purpose), lasting a few hours only, and thinks an expert quite justified in putting his name to a report based on insufficient data as may be determined by his employers. We take no objection to this if only it had been added that the expert, for his own credit's sake and the sake of truth, should draw special and pointed attention to anything, as, in the instance in question, want of sufficient duration of test, likely to vitiate results. Any really honest promoter knowing he has a good thing, and believing in it, should not seek an expert to find a given thing, but should ask for a report based on such a trial as the expert himself may determine to be necessary. No promoter, asking for public money, has any right whatever to lay down a single condition of a test. For purely trading information a man may lay down every condition, and an expert may work thereto without hesitation, but surely Mr. Nursey was not ignorant that his Halifax report was to be made public. Mr. McGlasson invites the promoters to have a really sufficient trial made. If they have a boiler that really does what they say it will, why should they hesitate to have it proved? Why, indeed, such a boiler evaporating 13 lbs. is worth far more than the £600,000 that is being asked for it. Only think of it—a saving of 30 per cent., at least, of the coal in all our big factories and electric stations. It would mean 750 tons a year for each 1,000 I.H.P.

Another correspondent, "Sigma," tries to get at the rate of combustion per square foot of grate. He assumes a grate area of 40 feet—fancy having to assume a grate area owing to its absence in the report of the expert, and finds that one of the small coal tests gives a rate of 28 pounds—an abnormal rate this for good clean round nuts—and 29·9 for Bradford house refuse. Now 40 feet does seem a big grate area, as "Sigma" points out, and the above rates of combustion are practical impossibilities. We do not believe them, no one believes them. Locomotive men will talk of an engine being nursed when it is wanted to show abnormal results, and it has been said that to keep a record engine out of the shops the platform of a well known station has been turned in effect into a repair shed. Really the whole falsity of the apparent results may very well have been secured by the shortness of the trials. What are we told as to the fuel used before the refuse began to be used? What weight of good fuel was there on the grate when the refuse trial commenced, and what was left on the grate when the test terminated? How was the water measured? If on the gauge glass, were the steam pressures equal at each end of the experiment? How easily a little point, neglected, may vitiate a result is well known, and, with every care, short tests are dangerous things on which to base conclusions. We hope by this that the Livet promoters are becoming awake to what it is they are really attempting, and that the investing public are also equally awake to the true meaning of the price they are being asked to pay.

On another page we publish a letter from Mr. Geo. F. Priestley, one of the directors of the Promoting Company, and so far as we know, the only one of the directors with any experience in steam boilers. Mr. Priestley's letter carries with it a far greater condemnation of the methods of the promoters than anything we have printed. After the Press was invited to witness a refuse destructor tested at Halifax, Mr. Priestley tells us that this destructor was not a refuse destructor at all, but built to burn coal. He objects to our bringing up the Hopcraft furnace as a warning. We did so because the Hopcraft furnace was floated by the same doubtful method of invitations and refreshments, and if Mr. Priestley cares to continue the comparison in respect to the daily enquiries from steam users, we might add that the Hopcraft Company had their books full of orders from Wales, Durham, Germany, Devonshire, Manchester, Yorkshire, Sweden, and round London. Anything advertised widely to effect a saving will always be overwhelmed with enquiries.

Turning to the prospectus itself again, we find it headed with short extracts from the daily press, all of absolute inconsequence and valueless. Then over the leaf are various bold and contradictory statements. The first we note is that rubbish is equal to a third its weight of coal. Then it is stated that London produces 1,500,000 tons of refuse annually. This is equal to half a million tons of coal, and it is claimed this will give 87,818 I.H.P. Now, to produce this horse-power would require over 686,000 tons of coal at only 2 lbs. of coal per hour. Our promoters, therefore, are actually assuming to get a horse-power for less than 1½ lbs. of coal per hour, a simply absurd claim. However, granting for the nonce the half million tons, we then find that half a million tons of coal will cost £799,143. This means over 31s. per ton for coal. Whence did they get this figure. Who pays this for steam coal in London? By such statements do they find a saving to the London ratepayers of £625,000.

Then Mr. W. B. Marshall is shown to say that refuse is capable of evaporating 2 lbs. of water per lb. Its value has now, it appears, dropped to one-fifth that of coal, but Mr. Marshall puts his foot woefully into it, for he adds, as a matter of surprise, that not only will it evaporate the water, but maintain a pressure of 40 lbs. per square inch. Oh, Mr. Marshall!! Did you ever study a table of the physical properties of steam? And you, ye board of directors, did ye know what ye did in publishing such rubbish? Then there follow more foolish figures and a claim for an evaporation by Livet's system of 14·53 pounds of water per pound of coal as determined by D. K. Clarke.

This is all right, Mr. D. K. Clarke was the expert whose favourable opinion and excellent results of a test of the Hopcraft furnace were so widely sown by the promoters of that little scheme. The writer, when himself testing boilers and furnaces, has had occasion to deplore the results he has obtained well below the teens in evaporative duty. It is only great minds which can soar above a dozen pounds of evaporation. Finally, we have the asking for £400,000 for the rights in more or less expired patents, and we can only marvel that any body of men can have the face to issue such a claim upon such a prospectus, that any engineer can allow himself to appear as a supporter or endorser of such palpably erroneous rubbish. But we have failed to note one of the grossest omissions of all. Of the London refuse of 1½ million tons, one claim is that a third of it is combustible. This leaves a million tons of incombustible which will all require to be removed—it will not burn—it cannot be

destroyed. The prospectus has not a word to say as to its disposal. Instead, they endeavour to lead the reader to suppose complete disappearance of all the refuse put into the destructor. Thus, at best, the cost of removing town refuse is, after all, that of carting all of it to the destructor, and from two-thirds to three-fourths or four-fifths away again, a double cartage and a double loading up. We do not deny that town refuse has a combustible value, nor that when destroyed it would be right and proper to save the heat generated and cause it to do useful work and pay something towards, and, if possible, above, the cost of its removal. But we do think it extremely improbable that the very proper and sanitary system of destroying refuse by fire can be made to give large returns, and we are certain that the Livet destructor has no feature to render it better or more valuable than many other less costly apparatus. Mr. Priestley sends us a ferrotype of what purports to be a 1,200 I.H.P. destructor to consume two tons refuse per hour, another contradiction by the way. 1,200 H.P. at 2 lbs. of coal per hour equals 2,400 lbs., so that 1·86 lbs. of refuse is equal to 1 lb. of coal, according to Mr. Priestley.

This blue print shows a pair of Cornish furnace tubes, exposed to external pressure, and with flanged seams, no less than 4 feet 6 inches apart, of 7 feet diameter, the outer shells being 8 feet 6 inches. There are two fire grates 6 feet wide and 7 feet 6 inches long in each furnace, with a horizontal diaphragm of brick longitudinally between the two grates. The grate area is thus 180 square feet, according to scale, though it is called 200. What the thickness of the furnace tube may be is not given, but for so big a diameter it ought to be very thick in so slightly stiffened a flue, or else the safe pressure must be impracticably low.

Above the Cornish boiler is shown a cremator furnace, presumably for burial purposes. By dint of the double tier of grates—like ship's bunks—in each furnace, the grate area is got up to 180 square feet. Mr. Priestley is thus obtaining $6\frac{2}{3}$ I.H.P. per square foot of grate. If he were burning best Haigh Moor steam coal at 2 lbs. per horse-power hour he would require to burn coal at the rate of $13\frac{1}{3}$ lbs. per square foot per hour. This implies a consumption of refuse of from 40 to 70 pounds per foot. A rate of 25 pounds is magnificent work in the best arrangements with tall chimneys: 21 pounds is the maximum rate advised by the Manchester Steam User's Association, and yet Mr. Priestley, of Halifax, is to burn rubbish in a complex and intricate arrangement and pass it along at a rate of from 40 to 70 pounds per square foot per hour, with all the choking effects of dirt, dust, pots, tin and lead alloys, old cans, animal and wet vegetable *débris*, and if he should attempt to hasten the combustion by a fan draught he will very soon choke his flues with dust and smother the neighbourhood around with filthy dust from the chimney top. What Mr. Priestley and his associates can be thinking of to place themselves in line of such a mass of adverse criticism, as can be brought to bear on every detail and every figure they have put forward, is one of the things no one can understand. As a guide to investors we would add that with good steam coal it is considered to be verging on the impossible to get 1,000 I.H.P. from 80 square feet of grate surface, with best compound condensing engines and flue feed heaters. There are experienced engineers and boiler inspectors who deny that it has ever been done.

Electrisation of the Stomach.

A rather startling and almost amusing method of electrifying the stomach has been advocated by Dr. Max Euihom, in an article published a short time back in the New York *Medical Journal*. He starts with the view that in order to give the stomach full benefit of electrisation it is necessary to apply the current inside that organ. In order that this may be accomplished, he has devised a deglutable electrode, which takes the form of a hard rubber capsule, perforated with several orifices, having within it a metallic button connected to an insulated wire, 1 mm. in diameter, which forms the conducting medium, and is of sufficient length to project from the mouth when the electrode is within the stomach. The rubber capsule serves to avoid the direct contact of the metal with the stomach wall. The patient first drinks one or two glasses of water to fill the stomach. He then swallows the capsule, if necessary washing it down with more water. A mark on the conducting cord at a distance of 40 c. from the capsule, on coming to a level with the teeth indicates to the physician that the capsule has reached the stomach. By this method it is claimed that the stomach receives a sort of monopolar electric bath, the circuit being completed through the fluid with which the stomach is filled, and which necessarily comes in contact with the metal button within the perforated capsule, and an ordinary percutaneous electrode suitably placed on the surface of the body. There can be no doubt that the method admits of considerable localisation of electric action, and therefore we are inclined to think Dr. Euihom's idea may have a distinct use. We should fear, however, that the process, especially that part of it involved in the return ticket of the capsule, may prove sufficiently irritating to delicate stomachs to practically vitiate any benefit gained electrically.

A Reverberatory Electric Furnace.

Those who appreciated the electric furnace devised by M. H. Moissan and described in this Journal about a year ago, easily foresaw that it was but a step further, so to speak, to construct a reverberatory electric furnace. This has now been effected by Moissan, who recently described his new furnace before the Paris Academy of Science. The essential features of the furnace are as follows:—A block of Courson limestone, in the form of a parallelopiped, is hollowed out to contain a large cavity of similar shape, which is lined with plates of magnesia and carbon, so arranged that the magnesia is in contact with the limestone whilst the carbon forms the internal lining of the cavity. A lid, composed of alternate plates of magnesia and carbon, covers in the cavity, and a block of Courson limestone is placed above the lid. The electrodes are movable, and pass through slots cut in opposite sides of the furnace. At right angles to these electrodes is situated a tube of carbon from 10 to 20 mm. in diameter; it passes through the furnace, and is so arranged as to be 10 mm. below the arc and 10 mm. above the bottom of the cavity. The tube may be lined with magnesia. By inclining this tube at an angle of about 30°, the furnace can be made to work continuously, the reducible material or ore being introduced at the higher end, whilst the product of reduction is drawn off from the lower end. With a current of 600 ampères and 60 volts, Mons. Moissan succeeded in obtaining from the raw ore 2 kilogrammes of metallic chromium in about an hour. This form of electric furnace promises to be exceedingly useful in the commercial treatment of various refractory materials which have hitherto resisted the methods ordinarily in vogue. There appears to be a large future for this application of electricity, and we take it that Mons. Moissan would be the first to admit that his furnaces are mere *pioneers*, as it were, in this development of electrical industry.

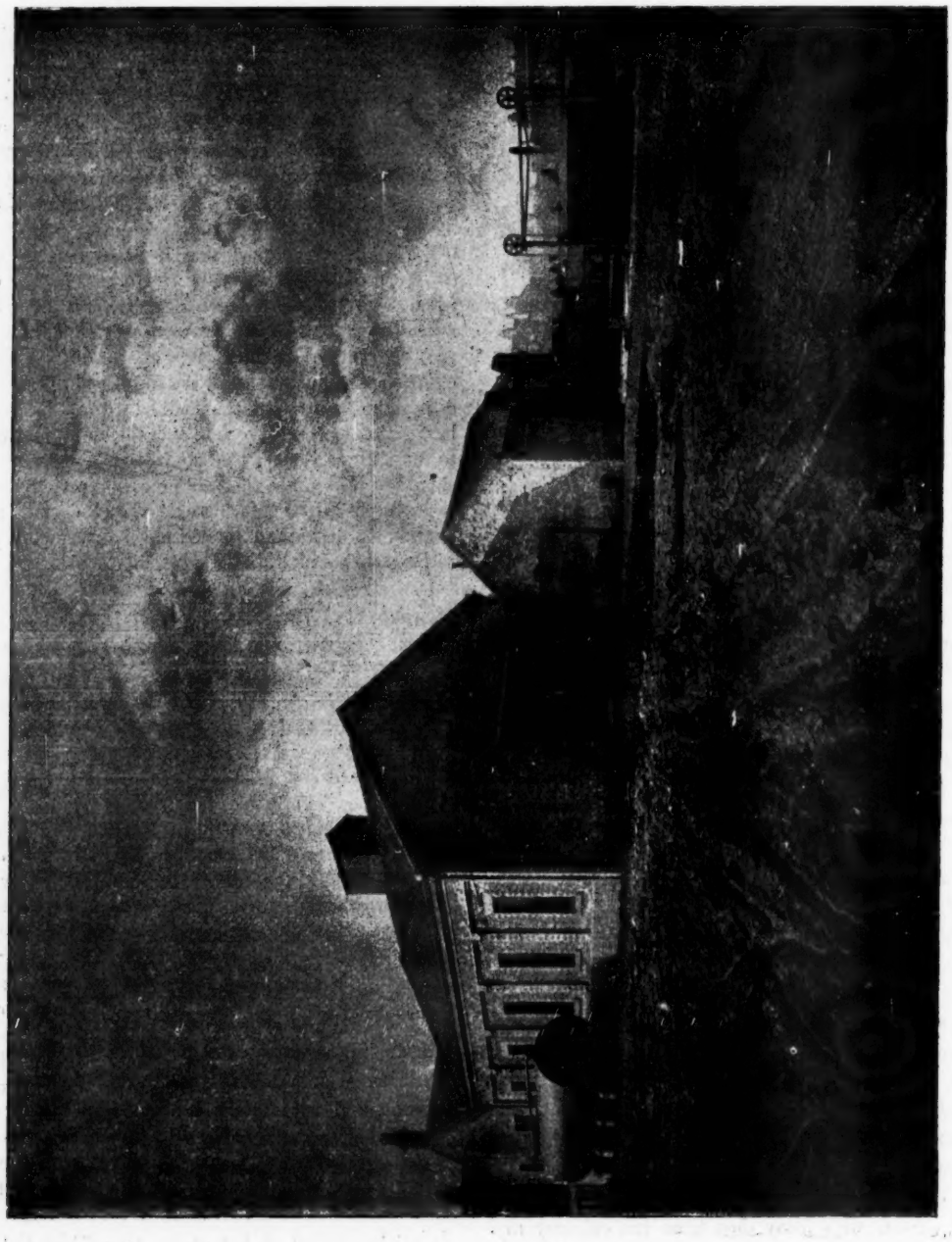
ELECTRICITY SUPPLY STATIONS.

No. 17.—Coatbridge Station.

Description of Works.

System.—The current is distributed to the various customers on the low tension alternating system, the mains being fed from transformers fixed in the underground chambers placed in convenient parts of the town. The transformers are operated by high tension feeders which run from the generating station. The alternators are driven by gas engines entirely, while the gas is made in producers at the premises.

Buildings.—The generating station is built on a plot of land lying between Dundyvan Street and Hutton Street, and conveniently adjoins the North British Railway, from which a siding has been specially run into the works, thus securing the maximum economy in the delivery of fuel and other stores. The entrance to the buildings, which are of brick, is in Dundyvan Street, the offices being nearest the street. The offices comprise a general office, waiting room, board room, engineer's office, testing room, and stores. The floors of all these rooms are raised above the level of the works, the engineer's office being so situated that the engineer can command a general supervision of the whole of the engine and dynamo room. Passing through the offices, we come into the engine and dynamo room, which is 53 feet long by 38 feet wide, and while only of sufficient size for the accommodation of the present plant, it is so arranged that the end wall may be easily removed for extension. This room is lined with white glazed bricks. The roof, which is slated, is open, and is supported by stays and tie-rods of wrought iron. It is panelled inside with pine, stained and varnished.

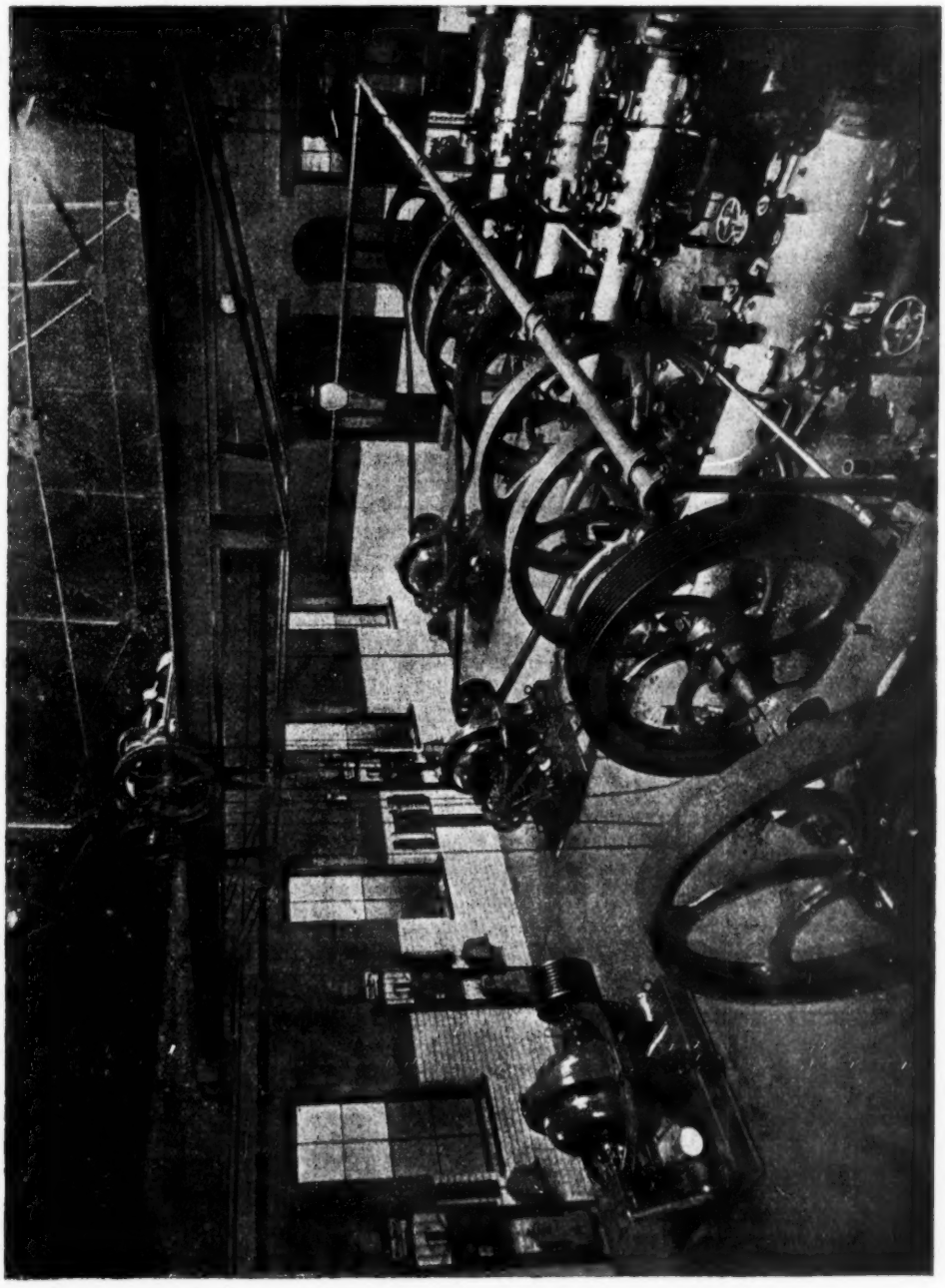


End View of Works, Showing Gas Plant.

The floor is made of granolithic cement of a warm red colour, which gives to it a neat and comfortable appearance. For convenience in operating the machinery, there is fixed a very useful and handy 5-ton travelling crane by Carrick and Ritchie, of Edinburgh. Between the dynamo room and railway siding is the producer house, so arranged that fuel may be unloaded direct from the truck on to the charging platform; while the producers are placed in a pit so that the hoppers are at a convenient level. Thus the minimum amount of labour is required for passing the coal from the truck into the producer.

Gas Generating Plant.—There are two gas producers, each

capable of generating gas for 120 brake horse-power, and they are fitted with Hartley's improved apparatus for removing clinkers. Each producer has an independent set of cooling and cleaning apparatus, consisting of atmospheric cooler, hydraulic box for arresting the passage of dust, &c., coke and sawdust scrubbers, with valve and connection to the gas-holder. There are two small steam boilers for supplying the small quantity of steam required for making the gas, together with steam for starting the gas engines. The gas-holder is 15 feet diameter by 10 feet deep, and works in a brick tank constructed in the ground adjoining the producer house.



General View of Interior of Works, Showing Gas Engines, Alternators, and Switchboards.

Gas Engines.—These are of the double-acting type, with an Otto cycle. Each engine has two cylinders placed side by side, and runs at a speed of 180 revolutions per minute, at which speed they are to develop up to 120 indicated horse-power. A high speed sensitive governor of the Buss type controls the supply of gas and air, the quantities of which are varied to suit the load down to one-third of full power, below which the governor cuts off a certain number of explosions in the usual way. For starting the engines steam is used. It is admitted by a valve operated by a hand lever, which the attendant opens and closes in the same way as a slide valve is worked by an ordinary eccentric. To ensure steadiness each pair of engines is fitted with three fly-wheels, so that there is one on either side of each crank; the middle fly-wheel is grooved for rope driving. For circulating the cooling water, which is contained in a large tank outside of the engine room, there is used a small centrifugal pump driven by an alternate current motor. This motor is operated from the low tension mains which serve for lighting the station, and is at once an interesting and positive assurance of the suitability of the alternate current for power distribution. A "stand-by" connection has been made with the water company's mains in case of mishap to the pump. The whole of the gas plant and gas engines are made by Messrs. Dick, Kerr & Co., Limited, Kilmarnock, who have been ably represented throughout by their manager, Mr. J. W. Hartley.

Alternators.—These are of the well-known Mordey-Victoria type, and of the A 10 size. Each generates 50 kilowatts at 2,000 volts pressure, the speed being 600 revolu-

tions per minute. The pulleys are 24 inches in diameter, with grooves for eight ropes 1 inch in diameter. The speed of the ropes is consequently 3,770 feet per minute, and the net stress is equivalent to about 100 lbs. per square inch of rope. With a view to ascertaining the most suitable class of rope, one of the alternators is driven by cotton, the others by manilla ropes. The alternators are set in sliding beds, built in flush with the floor, which gives a neat appearance to the machines. Amongst the chief features of the alternators are the stationary armature, any coil of which can be replaced in a few minutes; heavy revolving pole-pieces excited by a single coil concentric with the shaft, thus giving great steadiness of motion and freedom from wear and tear of coils; perfect parallel working at all loads, and with all sizes of machines. This has been demonstrated by the parallel working of these alternators at Coatbridge, which are the first alternators which have been so run with gas engines. It is also claimed that the alternators have an unusually high efficiency at all loads.

The power of being able to run in parallel has a most important bearing on the all-year-round economy of working, since it is never necessary to run more plant than corresponds with the total load. This is frequently the case when alternators are run on separate circuits, and the engines may frequently be working under their full power, and consequently with a falling off in efficiency. The output of the three alternators is 150 kilowatts, or 5,000 lamps of 8 C.P. each.

Exciters.—There are two Victoria dynamos used, either of which is capable of exciting all three alternators at one time. They are driven by belts off the shafts of two of the alternators.

Switchboards.—For these the Brush Company's standard system has been adopted. Opposite each alternator there is placed an alternator switchboard, on which are provided all the necessary switches and cut-outs, both for the primary and for the exciting circuit. The switch for the exciting circuit is provided with a carbon break. The primary switches are closed and opened by cords, which avoids all danger of the operators touching H.T. parts. On each board is also provided ammeters for both primary and exciting circuits, together with a voltmeter and voltmeter transformer for indicating the primary voltage. There are, in addition, a pair of sockets for connecting the alternators to the synchronising wires. Each alternator board is connected to an omnibus conductor, through which the current passes to the instruments for measuring and recording the total output of the station, viz., a main ammeter and a registering meter; there is also a registering voltmeter. For convenience these main instruments are placed on a shelf on the synchroniser board. Under the shelf are placed the synchronisers, while above these are switches for cutting out the main instruments, as well as for closing the synchroniser circuit. On the top of the board are two lamps, which are used in the ordinary way for synchronising. At present there is only one circuit board containing main switches and cut-outs, together with an ammeter. All these boards are so arranged as to make future extensions as simple as possible. There is also a switchboard for the two exciters, with change-over switches and volt and ampèremeters.

Description of Distributing Plant.

High-Pressure Feeders.—These consist of separate stranded conductors, insulated with thick coatings of pure and vulcanised India-rubber protected with braiding, and drawn into 3 and 2-inch cast-iron pipes. From the generating station to the first transformer sub-station there are two pairs of 7/14 conductors, thence to the second sub-station, and on to Dunbeth Street run one pair of 7/14's, while up this street to the sub-station at the Municipal Buildings are one pair of 7/16's. A spare cast-iron pipe has been laid in the ground along the route, in order to provide for easy extension, and, in addition, there is laid a 1-inch wrought-iron pipe for receiving special arc lighting mains. It will be an easy matter to withdraw any length and substitute a larger cable, when occasion requires, without breaking up the road.

Low Pressure Distributing Mains.—As a "draw in and out" system for this purpose is not desirable, owing to the various house connections in each length of conductor, the distributors consist of stranded cables having ·15 or ·1 square inch section, insulated with vulcanised bitumen, and laid in cast-iron troughs, which are then run in solid with bitumen, and covered with a cast-iron cover plate. The streets in which these mains are laid are Bank Street, Main Street, Sunnyside Road, and Academy Street.

Transformer Sub-stations.—As already mentioned, there are at present three of these, one at the corner of Hutton Street and Bank Street, the second at the junction of Academy Street with Main Street, and the third near the Municipal Buildings. They consist of underground chambers, about 5 feet square by 6 feet deep, constructed under the pavements at convenient points in the line of the mains. Each chamber is substantially constructed, and is connected with the main drain, so that no water may accumulate. Ample provision has also been made for ventilation. The entrance is by a manhole in the pavement about 2 feet square; this is closed by the usual street box cover.

In each chamber there are two 18-kilowatt transformers, which are capable of supplying 1,200 8-C.P. lamps at one time; these are of the Mordey-Victoria type, each being closed in a watertight cast-iron case, and having double pole primary fuses and switches in the top of the case. The connections to the primary mains are made through cast-iron boxes containing isolating switches, while the secondary mains are connected to omnibus bars, and thence to the transformers, through switches and fuses specially designed by the Brush Company for this purpose with Raworth's patent contacts. Either transformer may be switched off the low tension bus bars, leaving the others to supply current, and it will thus be seen that the arrangements permit of complete isolation of any transformer, without affecting the supply. It is claimed for the Brush Company's transformers that they are specially suited for central station work, having a very small loss at light loads, the open circuit loss being about 1 per cent. only of the full load, while the full load efficiency is as high as 97 per cent.

Extension of Distributing Plant.—From the above it will be seen that this is most easily accomplished, without increasing or interfering with the low tension mains and house service connections; for whenever the demand exceeds the capacity of the main, it is merely necessary to construct an additional transformer chamber, which has at once the effect of doubling the capacity of the low tension mains at that point, while the high tension mains already have spare carrying capacity, and provision for drawing in another H.T. feeder. Thus there is provided every facility for extension without again breaking up the streets, so far as concerns those thoroughfares in which the mains are already laid.

In conclusion, it should be mentioned that the successful completion of the work is largely due to the enterprise and indomitable energy of the Scottish House-to-House Electricity Company's managing director, Mr. Angus Macleod, whose untiring zeal has been always at the company's disposal, not only during the initiatory stages, but also throughout the construction of the works. The supervision of the work has been in the able hands of the company's resident engineer, Mr. Francis Teague, M.I.E.E., acting under the direction of Mr. Wm. A. Bryson, M.I.E.E., F.R.S.E., the company's consulting engineer, while the construction of the electrical portion of the work, as already stated, has been carried out by the Brush Electrical Engineering Company, Limited, under the supervision of their capable and courteous superintending engineer, Mr. W. Geipel, M.I.E.E.

The buildings, which are of a very substantial and appropriate character, have been designed by and erected under the supervision of Mr. Alexr. M'G. Mitchell, architect, Coatbridge. It is due to this gentleman to add that the general arrangement of same leaves nothing to be desired on the score of convenience, comfort, and economy. Mr. Mitchell has taken a most active interest in the undertaking since its commencement.

TELEGRAPHING BY INDUCTION

A very interesting series of experiments was lately made by Mr. Charles A. Stevenson, C.E., in fields on the farms of Damhead and Saughton Mains, near Edinburgh, with the view of proving that it was possible to communicate between lighthouses erected on rocks and lighthouses out at sea and the land stations without a submarine cable requiring to be laid.

The laying and maintenance of a submarine telegraph cable to rock lighthouses is not only difficult but expensive, and there is great doubt whether such a cable could be maintained, as the continual action of the sea would soon destroy the armour of the cable. Overhead wires would not only be difficult to erect, but their life would be short. It occurred to Mr. Stevenson that if his coil system were tried and found satisfactory the desired end would be gained at a comparatively small cost. After a number of laboratory experiments had been made to ascertain the laws of the action of the coils on each other and the number of turns and diameter of the coils necessary with commercial telephones, it was considered necessary to test the system on a large scale to prove whether the gap of 800 yards between North Uist Lighthouse and the shore could be bridged by induction. Two coils, 200 yards in diameter of nine turns each of ordinary Post Office telegraph wire, were erected on poles 800 yards apart at Murray Field, but so well did the system act that, owing to induction currents from the Edinburgh and Glasgow Railway telegraph lines (distant from the experimental fields 200 yards), the messages could be quite easily read, although the coils were entirely insulated and were not "earthed." One of the messages read, for example, was "I think she will make a very good housekeeper. I shall congratulate her when I see her." The North British Railway Company's engineer kindly stopped sending messages with a phonopore on his line, as it interfered with the trial. It was then found that messages could be sent with 10 cells with perfect ease, and even with only five cells. The experiments were thus entirely successful, and the application of this novel coil system has a much wider application than communicating between rock lighthouses and the shore, for warships could have coils placed on them to assist in their manœuvres, and they could thus establish instantaneous communication between each other.

WATT-HOURS PER POUND OF COAL.*

By H. M. SWETLAND.

We are requested to furnish facts regarding the amount of coal used in actual practice to produce a given quantity of electricity. The information was obtained by correspondence, and furnished the committee in ampères, volts and hours on each circuit, and the amount of coal used covering this period, including that used for banking fires, &c. The aggregate electrical output for 24 hours was then calculated and compared with the total amount of fuel used, giving the watt-hours per pound of coal. All improbable and apparently erroneous reports were discarded, and the tabulated statement herewith comprises intelligent replies from a large number of the electric stations, including many of the leading corporations. The great saving in operating in large units and running continuously is plainly shown by the report, which shows 208 watt-hours per pound of hard screenings where about 8,000,000 watts were generated, running full 24 hours, as against the report which claims only 30 watt-hours per pound of soft coal, the total output being less than 60,000 watts and the service being furnished only seven hours. The best reports do not compare favourably with the results secured in generating power for manufacturing purposes.

In order to facilitate this comparison, we have prepared a table based on 90 per cent. mechanical efficiency in the engine and the same efficiency in the dynamo directly at the machines.

Then $\frac{746 \times \cdot 90 \times 90}{\text{coal per hour}}$ = watt-power per pound of coal.

And

Coal per hour per I.H.P.		Watt-hours per lb. of coal.	Coal per hour per I.H.P.		Watt-hours per lb. of coal.
1·5 lbs.	should produce ...	402·84	9 lbs.	should produce ...	67·14
2	" " ...	302·13	10	" " ...	60·43
3	" " ...	201·42	11	" " ...	54·93
4	" " ...	151·06	12	" " ...	50·35
5	" " ...	120·85	15	" " ...	40·28
6	" " ...	100·71	18	" " ...	33·57
7	" " ...	86·32	20	" " ...	30·22
8	" " ...	75·53			

* Abstracted by *Electrical Engineering* from the report published by committee on data of the National Electric Light Association.

From this estimate of engine and dynamo loss, 1½ pounds of coal should produce 402·24 watt-hours. We have a report from the Chelsea Jute Mills, of Brooklyn, New York, covering a period of six days, where an average of 653·3 indicated horse-power was developed from a coal consumption of 1·482 pounds per indicated horse-power per hour, the load varying from 495·21 to 764·96 horse-power.

This equipment consists of Corliss compound condensing engines and vertical tubular boilers. The plant was in operation ten hours each day. The figures given cover the whole amount of fuel used, including banking, &c. The fuel used was George's Creek bituminous coal.

If our percentage of efficiency is correct, and if we could have a fairly uniform electrical output, this plant ought to produce over 400 watt-hours, or double that of the most favourable report given us, more than double that of the next best report, thirteen times the efficiency of the plant making the lowest report, and between four and five times the average efficiency of the whole report.

The correspondence shows a marked interest in the work, and many returns were accompanied by a request for information showing how their report compared with others. We believe the tendency of the work is to encourage more careful records, which in turn assists in locating and eliminating losses, and we hope future reports by this committee will show a much better average than 91·7 watt-hours for one pound of coal.

THE LAW OF HYSTERESIS.

The recently published experiments of Prof. J. A. Ewing and Miss Helen G. Klaassen, upon "The Magnetic Qualities of Iron," which appear in the *Phil. Trans., R. S.*, Vol. 184, include some notes upon the empirical formula of Mr. C. P. Steinmetz. In a paper read before the American Institute of Electrical Engineers, in 1892, Mr. Steinmetz discussed certain experiments on the relation between $\int H\,dI$ and B, and contended that the formula

$$\int H\,dI = \eta B^{1\cdot6},$$

η being a constant factor, is in close agreement with practical measurement. In view of the extensive use of such a formula by designers of transformers, Professor Ewing and Miss Klaassen have carefully examined its range of accuracy.

Taking a ring of thin sheet iron, for which a numerous and very consistent series of determinations of $\int H\,dI$, extending from B = 43, to B = 14,720, they tested the constancy of the index ϵ, in the formula

$$\int H\,dI = \eta B^{\epsilon},$$

by plotting log B in relation to log $\int H\,dI$.

From B = 2,000, to B = 8,000, the curve obtained in this way is a straight line giving the value 1·475 for the index ϵ, and 0·01 for η. When B is about 8,000, the inclination of the line changes; and from B = 8,000, to B = 14,000, the curve is nearly a straight line giving ϵ = 1·70, and η = 0·00134. Small cycle tests upon the same ring show that from B = 200, to B = 500, the curve of log B and log $\int H\,dI$ is very closely a straight line, where ϵ is 1·9. When B is above 500, the gradient of the line gradually changes. Taking the region from B = 500, to B = 1,000, the value of ϵ is 1·68; while, from B = 1,000, to B = 2,000, it is 1·55.

From these results it is concluded that no formula of the type under consideration, with a constant index ϵ, will serve to represent the results with anything like the limits of experimental accuracy. The index begins by being two or nearly

two (a result which follows from Lord Rayleigh's experiments, *Phil. Mag.*, March, 1887): in the ring referred to, this decreases to about 1·47 at the region of high permeability, and then increases again to 1·7. The changes in the index correspond to the passage from one to another of the familiar successive stages in the process of magnetisation; comparatively high values of the index are found first in the initial stage, of low permeability, and again in the stage of strong magnetisation; when the permeability is reduced by the approach towards saturation, while in the intermediate stage, where the curve of B and H is steep, the index is decidedly low. The well-marked changes of gradient which characterise the magnetising are accompanied by scarcely less well-defined changes on the part of the index ϵ, and the factor η, in the empirical formula devised by Mr. Steinmetz.

The experimenters, however, point out, that while a formula of this type cannot be admitted to have any physical significance, it may still be serviceable in giving rough approximations for the purposes of an electrical engineer, though the formula is by no means to be accepted as an equation to the actual curve of $\int H\,dI$ and B, the curve which it gives by a suitable choice of index ϵ, and factor η, lies fairly close to the actual curve, intersecting it at an intermediate point as well as at two extremes. And it is the case, that an index of 1·6, or a number approximating to that, gives a curve lying, generally, in the neighbourhood of the true curve throughout the range of B, which is of most practical importance. For the particular ring experimented with, the formula

$$\int H\,dI = 0{\cdot}0034\ B^{1{\cdot}6}$$

gave values of $\int H\,dI$, which, within the range of the observations in question, were nowhere so greatly divergent from the truth as to unfit them for use in calculations connected with transformer design.

A NEW FORM OF PRONY BRAKE.*

By R. C. CARPENTER, M.Am.Soc.M.E.

A new form of Prony brake, recently described before the American Society of Mechanical Engineers, and illustrated in the figures, was designed by the writer about two years ago, and three such brakes, each of about 60 horse-power capacity, have been in use on the experimental engine of the Sibley College laboratories at Ithaca, N.Y., for a considerable portion of that time.

* *Cassier's Magazine.*

The brake consists, in each case, of a tube of copper, with an elliptical section, which nearly encircles the brake wheel. Outside the copper tube is an adjustable band or belt of sheet steel, which prevents the copper tube from expanding. Water pressure is applied to the copper tube by means of hose connections made near the centre of the wheel, to water

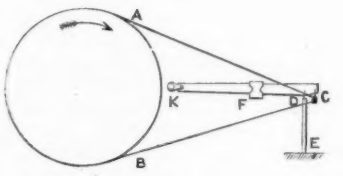


Fig. 1.

pipes, the amount of pressure being regulated by throttling the admission and discharge valves. As the external diameter of the copper tube cannot change, the internal pressure causes the inner surface to rub against the wheel, producing the friction which is used to absorb the work. To prevent the wearing of the inner surface of the copper tube, a thin sheet of steel or Russia iron is inserted between the tube and the brake wheel, and connected to the brake so as not to revolve.

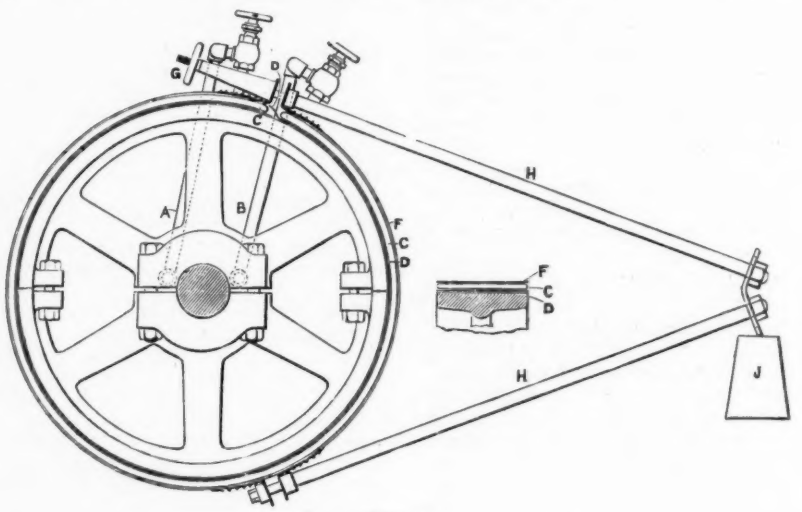


Fig. 2.

This brake has proved very satisfactory; the work is readily absorbed by varying the opening of the supply and discharge valves, and no trouble has been experienced on long runs from heat or irregular friction of the brake.

In fig. 2, which represents an elevation of a wheel, with the brake attached, the principal parts are: A, supply pipe; B, discharge pipe; C, brake; D, sheet-iron liner; F, external strap of sheet-iron; G, adjusting bolts in external strap; H, arms of brake riveted to external strap; J, support for brake arm, to be carried on the platform of the weighing scale. The wheel itself is 4 feet in diameter, and has a 12-inch face. The small detail view represents a section of the brake and of the rim of the wheel. The elliptical brake is marked C, the larger diameter being 12 inches, and the shorter one $\frac{3}{4}$ inch; F, is the external strap, and D is the sheet-iron liner. Another merit, which in some cases may be of little moment, but which was of considerable importance at the time of its erection, was the fact that the first cost was small, the brakes not costing over 50 dollars each.

Prof. C. W. Scribner designed a self-regulating device which I consider of great merit, but which, because of pressure of other work, has not yet been applied to the brakes just described. There is, however, no doubt of the effectiveness of the design, and a description of it is therefore given. So far as the writer knows, every previous device for automatic regulation of the work absorbed by a brake requires the rotation of the wheel to be such as to tend to move the free end of the brake arm in an upward

direction. This is often objectionable, and sometimes an element of danger. In this case Professor Scribner permits a downward motion of the brake arm, and yet succeeds in securing motion sufficient to adjust the tension on the brake.

The general method of securing the adjustment is shown in fig. 1, in which A C and B C are the brake arms; these rest on the end of a horizontal lever, K C. This lever is supported at D by a knife edge on the fixed support, D E. A movable weight, F, is placed on the arm of the lever at any point needed to give the required brake load. If the brake load be too great, the pressure at C is greater than at F, and the point, K, of the lever rises. On the other hand, if the brake load is too small the pressure at F is greater than at C, and the end, K, of the brake arm falls. The motion of this point can readily be utilised to decrease or increase the tension on the brake as required. In this case this motion will be utilised to regulate the opening of the supply valves and to vary the pressure on the brake. The weight, F, can also be utilised to weigh the load.

PRESENT CONDITIONS OF INSTALLING ELECTRIC MAINS IN THE PREMISES OF CONSUMERS SUPPLIED FROM CENTRAL STATIONS.

During the ten years that electrical companies have been supplying private consumers with the electric light, very little progress has been realised in either the construction of the apparatus or the laying of the mains required in these installations.

The exceptional situation in which we recently found ourselves led us to study minutely the construction of the various types of apparatus in use up to the present day, and the conclusions we drew from our investigations seemed to us so interesting, that we thought it would further the interests of electrical industry to bring them to the knowledge of the readers of this journal.

For the sake of clearness, we will divide our article into two parts. In the first, we will discuss the smaller instruments, including the circuit-breakers, interrupters, &c.; in a word, all the instruments which are the indispensable accessories of every electrical installation; in the second we shall consider the different methods of laying the conductors in dwelling houses.

1.—Apparatus.

Circuit-breakers.—At first sight these instruments seem easily obtainable, their construction is simpler than that of the interrupters, and cannot lend itself to so great a variety of combinations.

However, notwithstanding the simplicity of construction of these instruments, we can affirm that none that we have been able to procure have fulfilled the purpose for which they were intended.

It will perhaps be said that we are going rather too far in making this remark. But the investigations and experiments that we have made have shown us beyond a doubt that our assertions are well founded.

Our investigations were pursued under the following conditions: We settled first, as completely as possible, what conditions such instruments should fulfil, and we then devoted ourselves to the examination of the various types, to see how far these conditions were realised. What we most want to examine in a circuit-breaker is the fuse. We know that the point of fusion of a certain type of fusible metallic wire of a certain diameter varies with the length of the wire.

To show the importance of this rule, we reproduce in fig. 1 the results we obtained from cylindrical fusible wires, the diameter of which varied from ·25 to 3 millimetres.

We see by this diagram that a wire, 3 millimetres in diameter, melts at

68	ampères	when	the	length	employed	is 42 mm.
71	"	"	"	"	32	"
77	"	"	"	"	25	"
130	"	"	"	"	12	"

This curve shows also that the difference between the points of fusion decreases as the length of the wire used increases.

From these conditions it follows that it is of great advantage for those who have to fit up installations, and especially installations for sectors, to employ circuit-breakers, in which the length of fusible wire to be inserted shall be the same for all.

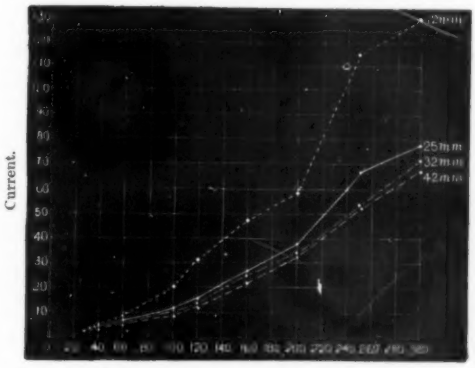


Fig. 1.—Diameters of the Wire in Hundredths of Millimetres.

On examining as to whether the makers had endeavoured to obtain this uniformity by constructing their apparatus in accordance, we were very much surprised to find that they had not.

Instruments sent out from the same factory showed great differences in this respect. We found some in which the length of wire introduced would not amount to 8 millimetres, and others in which it would attain to 4 centimetres. No rule had been followed for the determination of these lengths, but we may say that they generally increase with the intensity of current that the instrument is capable of bearing.

This intensity should not, however, be the only point taken into consideration; we should also pay special attention to the maximum difference of potential that can exist between the two terminals. Now, this has not been considered at all; we have seen circuit-breakers constructed for systems of 440 volts, only allowing of the insertion of fusible wires 2 centimetres in length. This length is evidently insufficient to bear such a great difference of potential. On the lead being melted, the arc must infallibly remain, and bring about the melting of the terminals of the circuit-breaker.

On the other hand, we could not expect that the length of wire required for the circuit-breaker that is to work at 30 ampères will be exactly equal to that required for a circuit-breaker that is to work at 5 ampères. We shall thus be led to construct instruments requiring lengths of lead varying for each intensity of current.

In order not to increase the number of instruments, it will be best to fix upon equal lengths for intensities of current comprised between two determined values, from 1 to 15 ampères, for instance, for the branch circuit-breakers, and from 15 to 30 ampères for the line circuit-breakers; and constructed so that they work normally for the maximum intensity that they have to support.

If we try the instruments constructed up to the present, we shall find that if they contain different lengths of lead according to the intensities they are to support, these lengths are insufficient even for 100 volts, which is the minimum difference of potential employed in distributions of electricity. In this way we tried, over a current of 100 volts, instruments of different intensities, sent out by various makers, with a current of an intensity equal to that for which they were constructed, and we found none that could stand a short circuit without the arc remaining between the terminals after the lead was melted.

In almost every case, with circuit-breakers mounted on porcelain and furnished with covers of the same material, short-circuiting caused in a moment the total destruction of the apparatus. Even very thick covers (6 millimetres) were shattered into fragments, and in some cases thrown to a

distance of some metres. The arc remained between the terminals of the apparatus, and would have continued for a moment if we had not interrupted the passage of the current.

Thus these apparatus, which are intended to protect electrical conductors and the apparatus connected with them from abnormal heating, do more harm than good. It was thought that their employment averted all risk of fire, and less care was taken to keep them away in rooms from all inflammable objects, and especially from the draperies behind which they are often concealed.

Amongst the circuit-breakers tried, some, which were constructed to work at 30 ampères, had leads 4 centimetres long, and, notwithstanding this length, which was comparatively great, the arc still remained, and the terminals were again melted.

We see, then, that with this kind of circuit-breaker, with naked wires, we should have to increase the length of the fusible wires very considerably, and that the instruments would be of such dimensions that it would be impossible to employ them in rooms.

Independently of the grave defects that we have just mentioned, the majority of circuit-breakers have many others that cannot be passed over in silence.

Besides the influence that the length of wire exercises over the good working of the circuit-breaker, we must also take into account that of the points of attachment. As a rule the introduction of the fusible wires along the course of the conductors to be protected, is effected by means of terminals, on which the fusible wires are held by means of screws.

If these screws are turned too tightly there is always a rubbing, and very often the wire is broken. If, on the other hand, the screws are too loose, there is a gradual heating, the lead dilates on one side, the contact becomes worse and worse, and the heating becomes such that the fusible wire melts and causes an untimely extinction, although no disturbance is caused in the installation.

In order to avoid these untimely fusions, well known to electricians, and which occur far too frequently in installations, it has been proposed to solder to the two extremities of the fusible wires pieces of less fusible metal, generally copper. The screwing is then effected on these pieces of copper, and a very close contact is established between the fusible wire and the conductor to be protected. By this method the closeness of the contact always remains the same, but unfortunately it is little used, especially for fusible wires of small diameter.

According to the intensity which is to pass through the apparatus, we employ fusible wires or plates.

Fusible wires are used more especially for low intensities, and they are rarely used above 3 millimetres in diameter. In all cases above the section corresponding to this diameter, fusible plates are exclusively employed.

The section of a fusible wire is generally calculated according to the density of the current expressed in ampères per square millimetre of section, according to the kind of alloy chosen. Now this rule cannot be rigorously applied when cylindrical wires are used. In this case the cooling surface is not in proportion to the section; the more the diameter is increased, the less will be the density of current causing the fusion.

With plates, on the contrary, if we take care to have a fixed thickness, and to increase the section by increasing the width, we find that the density of current remains to all intents the same, which is owing to the fact that the cooling surface remains to all intents proportional to the section.

We show in fig. 2 a curve obtained by varying the width of a plate of lead 1 millimetre thick. The curve is almost a straight line, which shows that the density has remained constant.

Another objection to the usual mode of attachment of fusible wires lies in the fact that it too readily allows of a melted wire being replaced by another with much too great a section. We have often found that consumers, in whose installations it was necessary to produce a short circuit, had replaced the lead before it was entirely melted by a wire or other piece of metal, thus suppressing all protection. Even when the consumer replaces the fusible wire properly, it often happens, especially when he has to do with bi-polar circuit-breakers, that he produces short circuits, either by using a metal tool, or by placing the fusible wire between the terminals corresponding to the two conductors of opposite poles.

To avoid the employment of metal tools for the replacing of the leads, movable bars are used, which are provided with lead before being introduced into the apparatus. This mode of fixing the leads is an important improvement in the construction of circuit-breakers, but it does not do away with untimely fusions, due to bad contact of the lead.

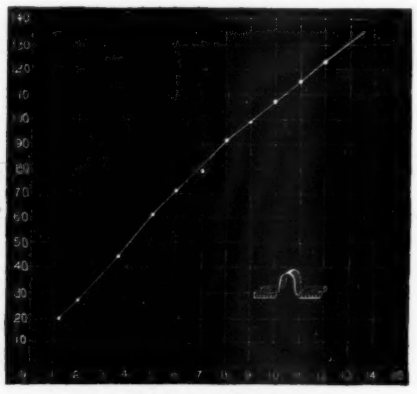


Fig. 2.—Width in Millimetres.

Another improvement introduced into a large number of circuit-breakers, consists in the interposition between the two pairs of terminals corresponding to wires of opposite polarity, a separating block of insulating material which prevents the accidental contacts that might take place when the leads are changed, and which clearly separates the apparatus into two distinct parts.

The employment of metal covers for unipolar, and especially bipolar, circuit-breakers, should be strongly condemned, for even when they are provided internally with a protecting layer of insulating material, which, by the way, does not last long, they are almost always the cause of many short-circuitings, owing to their being awkwardly handled. It has often happened that covers have melted in the hands of consumers and even of electricians, notwithstanding all the precautions which had been taken. It might be urged that with the circuit-breakers provided with separating blocks of insulating material, the contacts brought about by the awkward handling of which we have spoken would surely be avoided; but there are other causes which might produce the fusion of the cover. We are in possession of covers almost entirely melted by the arc formed by the projection of the lead in course of fusion, or again by a short circuiting produced by the defective placing of the fusible wires, the extremities of which were not cut off sufficiently near the terminals and so touched the cover.

We have up to the present found only two kinds of apparatus that satisfactorily answered the purpose for which they were constructed. These two are Edison's circuit-breaker and the fuse circuit-breaker. We will not enter here into the details of Edison's circuit-breaker, which was the first industrial apparatus, and which has no defect from an electrical point of view, but is not extensively used in industrial installations, owing to its large dimensions; we will only describe the fuse circuit-breaker.

P. Anney (*L'Industrie Electrique*).

(*To be continued.*)

GRAPHICAL TREATMENT OF ALTERNATE CURRENT CONDUCTORS IN PARALLEL.

By E. C. Rimington

In a previous paper* the writer has given a simple graphical method of finding the apparent impedance of the primary of a transformer when its secondary is closed, and with or

* Electrical Review, Vol. xxxiii., pp. 664 and 690, December 22nd and 29th, 1893.

without capacities in both the primary and secondary circuits. In the following he proposes to deal with the case of impedances in parallel entirely by a graphic method.

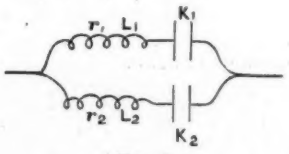


Fig. 1.

Consider first the case of two branches in parallel; let r_1 and r_2 be the resistances of the two branches, L_1 and L_2 their self-inductances, and K_1 and K_2 the capacities in them, as in fig. 1. Let $p = 2\pi n$, where n is the frequency. Suppose that $p L_1 - \frac{1}{p K_1}$ and $p L_2 - \frac{1}{p K_2}$ are both positive quantities.

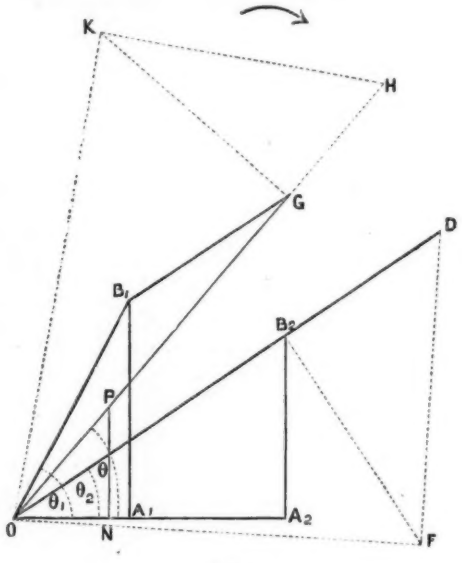


Fig. 2.

Draw a straight line, O A_2, and mark off on it to some convenient scale, O $A_1 = r_1$ and O $A_2 = r_2$. Erect the perpendiculars A $B_1 = p L_1 - \frac{1}{p K_1}$ and A $B_2 = p L_2 - \frac{1}{p K_2}$.

Join O B_1 and O B_2, then these lines represent the impedances of the two branches respectively, or I_1 and I_2.

Also the angle A_1 O B_1, or θ_1, is the lag of the current in branch 1 behind the impressed P.D., and the angle A_2 O B_2, or θ_2 that for branch 2, while the angle B_1 O B_2 or $\theta_1 - \theta_2$ is the phase angle between the two currents.

To obtain the joint impedance we may assume any P.D., find the two currents, obtain their vector sum, and divide this into the P.D. The simplest method of procedure is to suppose the P.D. numerically equal to the square of one of the impedances, say I_1, so that $E = I_1^2 = O B_1^2$. Then O B_1 represents, C_1, the current in branch 1.

Produce O B_2 to D, draw B_2 F at right angles to O D and make it equal to I_1 or O B_1. Join O F and draw F D at right angles to O F, cutting O D in D. Then by similar triangles

$$\frac{B_2 D}{B_2 F} = \frac{B_2 F}{O B_2} \text{ or } B_2 D = \frac{(B_2 F)^2}{O B_2} = \frac{I_1^2}{I_2} = C_2.$$

From B_1 draw B_1 G equal and parallel to B_2 D, join O G; then O G is the vector sum of O B_1 and B_2 D, or equals $C_1 + C_2$. Produce O G to H, draw G K at right angles to O H and equal to O B_1 or I_1. Join O K and draw K H at right angles to it.

Then $\frac{G H}{G K} = \frac{G K}{O G}$ or G $H = \frac{(G K)^2}{O G} = \frac{I_1^2}{C_1 + C_2} = I$, the joint impedance of I_1 and I_2. From O mark off O P equal to G H and drop the perpendicular P N.

Then O P represents the joint impedance of the two branches, the angle N O P $= \theta$ is the angle of lag of the total current behind the impressed P.D. O N is the ohmic resistance of a single conductor that would replace the two branches, and P N is its inductive resistance, or $\left(p L - \frac{1}{p K}\right)$.

In the case of the inductive resistances of the two branches, or $p L_1 - \frac{1}{p K_1}$ and $p L_2 - \frac{1}{p K_2}$ being both negative quantities, the figure would be the same, only we must suppose the direction of rotation reversed so that θ_1, θ_2, and θ will be angles of advance instead of angles of lag.

When one of the inductive resistances only is positive, say that of branch 2, we have the diagram shown in fig. 3.

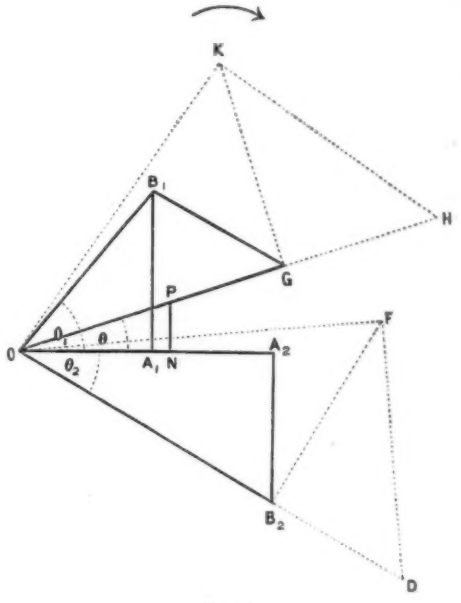


Fig. 3.

The construction is identical with that of fig. 2, and the same letters are used to denote corresponding points. In it θ_1 is the angle of lag of C_1, and θ_2 the angle of advance of C_2, the angle θ of the main current comes out with the values taken as an angle of lag. It is pretty obvious from fig. 3 that, since the main current, O G, is the vector sum of O B_1 and B_1 G, if the angle B_1 O B_2, or $\theta_1 + \theta_2$, is very obtuse, O G may be much less than either O B_1 or B_1 G, that is, the main current can be much smaller than the current in either branch. The limiting case is when θ_1 is nearly a right angle, or branch 1 contains small resistance and large self-inductance, while θ_2 is also nearly a right angle, or branch 2 contains small resistance, no self-inductance and capacity, so that $\frac{1}{p K_2}$ is approximately equal to $p L_1$ if the resistances are about equal; then the main current will be very much less than either of the branch currents. Fig. 4 shows this when the angles, θ_1 and θ_2, approach 90°.

It will be seen that the main current, O G, is less than either of the branch currents O B_1 or B_1 G; while of course the joint impedance, O P, is consequently greater than that of either of the branches.

In practically working out numerical results by the above methods, the lines shown dotted in the diagrams need never be actually drawn. For example, in fig. 1, having drawn the impedances O B_1 and O B_2, produce O B_2, and with a pair of set squares get the line B_2 F, then with a pair of dividers mark the point F, the line, B F, not being actually drawn, but the edge of the set square acting as a guide to the dividers. A piece of metal, ebonite, or even cardboard cut out in the shape given in fig. 5, will be of assistance in finding the point D.

P is a small pin-hole placed at the intersection of the two

sides which are perpendicular to each other. Placing this pin-hole on F, and driving in a fine pin or needle point, the piece of metal is turned until one of its sides cuts the point

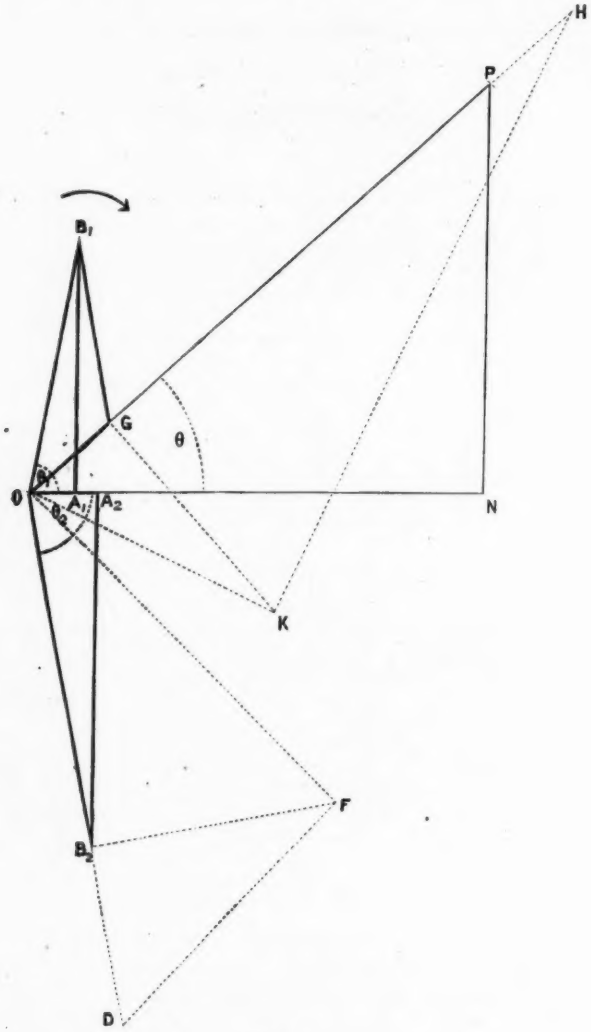


Fig. 4.

O, then the point where the other side cuts O B_2 produced will be the point D. In a similar manner the point H can be obtained.

When there are a number of branches, the same method can be applied to each to determine the current in it, the

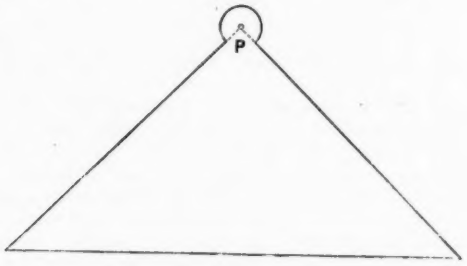


Fig. 5.

impressed P.D. being taken as the square of one of the impedances, which one does not matter, so the one of most convenient length can be used. The currents obtained must be added vectorially, giving the main current, and from this the joint impedance is obtained exactly as in the case of two branches.

Fig. 6 is an example. There are four branches, of which the inductive resistances of three are positive, and of one negative. Their respective impedances are O B_1, O B_2, O B_3, and O B_4. The P.D. is taken as equal to $(O\ B_2)^2$, making the respective currents $B_1\ D_1$, or $B_2\ G_1$, O B_2, $B_3\ D_3$, or $G_1\ G_3$, and $B_4\ D_4$, or $G_3\ G_4$. The main current is the vector sum, O G_4. The joint impedance is G_4 H, or O P, and the equivalent ohmic and inductive resistances are O N and P N respectively. The points, D_1, D_3, D_4, and H, were obtained by the use of the instrument represented in fig. 5.

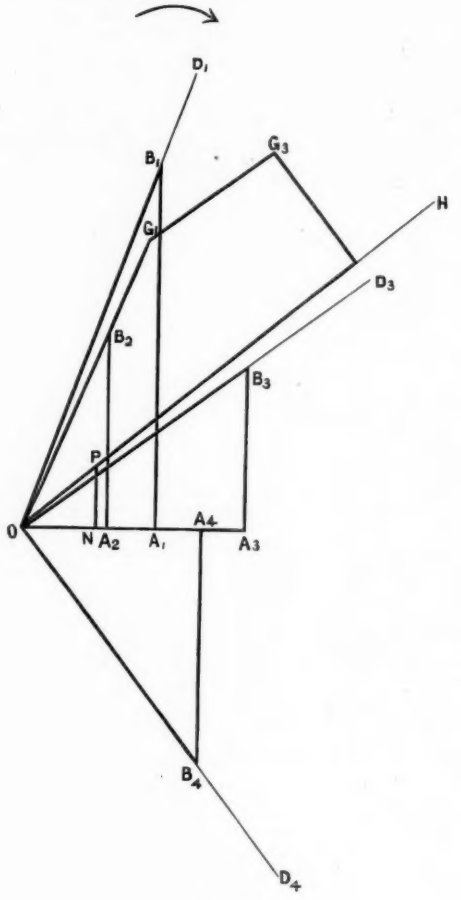


Fig. 6.

In all the above cases the branches are not supposed to act inductively on each other; when this, however, is the case, the apparent impedance and the angle of lag of each branch must be worked out in the manner given in the previous paper referred to above, and these values used for O B_1, O B_2, &c., θ_1, θ_2, &c., in the foregoing method.

PHOTOMETRY.

In his second lecture on Monday night at the Society of Arts, Capt. Abney once more insisted upon the incandescent carbon theory of flame. He dwelt again upon the fact that the electric glow lamp could be made to imitate the colour of most lights by increasing the temperature of the incandescent light. At a low temperature it matched the yellow flames, and at an increased temperature it matched the bluer flame of an Argand gas burner. A further proof of the existence of carbon in a flame was derived from Mr. Dibdin's experiments on a flat flame burner. A diagram illustrating the results of Mr. Dibdin's experiments was thrown upon the screen by the lecturer; the difference of luminosity dependent on the relative position of the screen and the light, was clearly established by the illustration. When the edge of the flame was presented to the screen, the intensity of the light fell off considerably. This variation

of flame in the two different directions varied between 10 and 35 per cent. This meant that there was an obstruction in the flame which cut off a certain quantity of light. The obstruction was due to fine particles of carbon suspended in the flame.

Comparing a Welsbach gas flame with the ordinary gas, they would notice the difference in the kind of light emitted. That from a Welsbach was greener, and they could never make an incandescent lamp of the same nature of light. The inequality of candle burning had been shown in his last lecture, and for all scientific working it must be dismissed as unworthy of serious consideration. The lecturer then went on to describe a few standards, confining himself to those which were suitable for ordinary use, namely, the amyl acetate, the pentane, and a newer one, an ether lamp. The amyl acetate was due to Hefner von Alteneck; it is remarkably simple, and required little manipulation. It consisted of a flame from a wick saturated with amyl acetate. The height which the flame should reach was shown by a gauge-rod fixed on the lamp. Some care was necessary in using it, but it was exceedingly convenient, and could be carried about. The next was a form of pentane lamp, worked out by Mr. Dibdin and Mr. Sugg. The lamp was minutely described by the lecturer. It was a standard of 10 candles, the pentane being a hydrocarbon. When the flame was turned up to a certain level it was exactly 10 candles, it did not matter whether the flame was too high or too low, it still gave the same visual intensity, so they had a very permanent standard. In the lecturer's opinion, the lamp was simplicity itself. At this point Captain Abney digressed to show the variation in the flame of the amyl acetate lamp with and without the chimney. Sugg's ether photometer was then described.

The lecturer then passed on to consider the comparison of lights. They had been told that Rumford's method was a comparison of shadows; it was nothing of the kind, said Capt. Abney, it was really the illumination by different lights of two surfaces close together. The divided surface was secured by making a rod cast a shadow. Captain Abney's practice was to mask the surface so that only a small square surface is to be examined. He was sorry to have to disagree with Mr. Dibdin regarding the Rumford method of photometry. In his book, Mr. Dibdin said, "the method is one which few practical photometrists of the present day would venture to adopt." From a very long experience, he, the lecturer, was convinced that it was as accurate, if not more so, than the Bunsen method. There were very few errors which crept into this method, and, said Capt. Abney, with a little warmth, a man must be a fool in order not to avoid them directly he saw them. One error that might be made was that the angle of light might not be the same, and the screen might not be perpendicular to the centre, another would probably arise if the photometrist did not always look in one direction. For great accuracy the illuminative shadows should touch.

The Bunsen method consisted simply of a piece of paper and a spot of grease, but as the lecturer significantly remarked, "There is grease and grease, and there are spots and spots." It was by no means an easy matter to get a uniformity in grease spots. He felt bound to quote Mr. Dibdin's opinion regarding this disc: "When first setting up a disc for use, several experimental readings should be taken, and if any material difference is found between the indications, when one side or the other is turned towards the standard flame, it should unhesitatingly be rejected, as no amount of after allowance can compensate for the trouble and doubt arising from contradictory results. The disc should be clean, and perfectly free from scratchings or markings of any kind. It is but sorry economy to work with a defective instrument. The gas referees went so far, a short time back, as to order a new disc to be used every week. As, however, a good disc, when taken care of, will last much longer than that period, the point has not been insisted upon; but that is no excuse for the continued use of a defective one, which should be ruthlessly destroyed as soon as detected."

From this, said the lecturer, we see that the disc is open to some objections, and it was for that reason that he preferred the shadow system. He was not alone in using the Rumford method, because one of the ablest photometrists, Mr. Vernon Harcourt, employed a modification of it, using the illuminating surfaces by a different plan (this will be seen from the drawing, in which a square space has been cut in a cardboard and a strip of black material placed across the centre of the space). Instead of using ground glass, Mr. Harcourt uses ordinary paper waxed with spermacetti petroleum, and the results he obtained were not to be disputed.

The lecturer then referred to the star disc, which was an improvement in the Bunsen method, introduced by Mr. Dibdin. This method had become a practical and serviceable one, and obviated the inaccuracy that might result from imperfect waxing.*

There was another way of getting a standard quantity of light by means of a slit placed in front of a light. The lecturer then showed how it was possible for errors to arise in these slits.

Next, Capt. Abney described Mr. Dibdin's radial photometer.

Coming to the method of judging the quality of light, they were told that the eye could appreciate one-sixtieth part of light. There was a case in which a celebrated witness, who was still living, was asked if such were the case, said "Yes and no." Capt. Abney said he should be inclined to give the same answer. The lecturer then showed an experiment which showed that the limits of vision were understated and overstated. A card painted to show the gradations from white to black was placed before a strongly focussed light, and the gradations were easily distinguishable, but when placed before a candle, the gradations were scarcely visible. In the best light one 200th could be distinguished between two gradations; this showed distinctly that it might be a case of yes and no.

The lecturer then went on to speak of the oscillation principle being good in photometry. If they allowed the eye to become fatigued, the brightest light would appear to balance the light, which was less bright. Capt. Abney then went on to speak of the scintillation of light.

THE ELECTRICAL TREATMENT OF INFANTILE PARALYSIS.

Mr. W. S. Hedley has written as follows to the *Lancet* regarding Dr. Lewis Jones's paper on this subject, which we published a few weeks ago in these columns:—

"Amongst the many points of interest dealt with in a paper read before the Medical Society of London on the 5th inst., and reported in the *Lancet* of the 10th inst., on the above subject, there is one which seems to me to merit further consideration. After describing the various forms in which infantile paralysis had presented itself to him, the writer of the paper in question proceeds to lay down 'a routine treatment.' This seems to consist of testing the muscles, measuring the limb, noting faulty positions, and handing over the case to the mother for electrical applications. 'He had found that mothers could easily be taught where to place the electrodes.' This, of course, must be conceded, in the same way that mothers could easily be taught where to apply a poultice; but does the question rest here? To me it appears that after all that has been done of late to rescue medical electricity from the hands of incompetent persons, and in view of the strides that have been made towards accuracy of application and exactness of electrical 'dosage,' such a procedure as that advocated above—even in view of the exigencies of the out-patient department of a general hospital—is distinctly retrograde; and not only retrograde, but what of the risks? Are there not, for example, cases

* Mr. Dibdin's improved Leeson's star disc is made of three pieces of paper, the two outer ones of thin paper, and the centre one of thick, with a star-shaped piece removed from the middle; the three papers are pressed together with very thin starch water, the disc then being dried under pressure. (See "Practical Photometry," by W. J. Dibdin.)

where a little lingering flicker of neuro-muscular excitability may be altogether extinguished by the very slightest amount of over-stimulation, and perhaps irreparable mischief caused? This question of self-treatment by patients and treatment by nurses and friends, has been asked and answered by most of those who have a right to be listened to on the subject, and their almost invariable answer is 'emphatically no.' Even in a text-book which bears on its cover the name of the writer of the paper in question there appears the following sentence:—'When patients are left to themselves with a battery the results are uniformly unsatisfactory, and the usual consequence is solely to bring medical electricity into disrepute.' If this be true of patients, who at least have their own sensations to guide them, how doubly true is it when applied to the case of the little patients in question. In my experience it not unfrequently happens that a child brought to me for electrical treatment begins to cry or scream at the first sound of the contact-breaker, and can scarcely be prevailed upon to approach the instrument. This is not always childish fear or fancy. It often tells a tale of previous faradaic torture, needlessly, though with the best intentions, inflicted by a nurse or mother, and possibly even may point to former 'vigorous faradaisation' at the hands of some practioner who is 'duly qualified'—in everything but to handle an electric current."

A THREE-PHASE TRANSFORMER.

The figure illustrates a three-phase transformer as used both for step-up and step-down transforming at the Jura-Simplon workshops. The primary and secondary bobbins are wound on three vertical laminated cores. These cores are united top and bottom by laminated circular discs. A primary bobbin and a secondary bobbin is slipped over each core.

The magnetic flow is like the electric flow in three-phase currents, while in one pair of cores the flow is from top to bottom; in the other one it is from bottom to top, so that this one at that instant forms the return path for the other two; but the flow in one of the pairs is a decreasing flow, while in the other it is an increasing flow, so that at a certain

instant the flow in each of the pair is equal, and the flow in the return one is a maximum, being twice that in one of the pair, as one decreases and the other increases, until one is zero and the other a maximum, a point is reached at which the flow reverses in one of the pair, and it then forms a new pair with the one which previously formed the return, while the one left now forms the common return. For a time these cycles go on in regular order, each core in turn forming the common return for the flow of the other two.

If we compare this construction with three separate closed magnetic circuit transformers, it will be found that the weight is as three as to four; for equal powers that is, on this construct, a 3 cwt. transformer would be equal to a 4 cwt. set of three separate transformers.

REVIEWS.

Petit Memorial—Agenda des Electriciens. 1894. Paris: L. Boudreaux, 8, Rue Hautefeuille.

This is a small book consisting of alternate leaves of advertisements and technical information in the shape of tables, formulæ, &c., such as are met with in mechanical and electrical engineering pocket-books and year-books. The usual diary is given at the end, and occupies about a quarter of the total pages. Information concerning the population, area, and municipal divisions, of France and its dependencies is also given. Tables of areas of circles, weights of metals, &c., of the usual class, make up the rest of the work, which, although fairly useful, is certainly not of a high class character.

Journal of the Institution of Electrical Engineers. No. 109. London: E. & F. N. Spon, 125, Strand.

This number contains the "Inaugural Address" of the President (Mr. A. Siemens), and "Notes of a Trip to the United States and to Chicago," by Mr. W. H. Preece. With the number is also issued the index for Vol. xxii.

Electro-Plating. By J. W. Urquhart. 3rd edition. London: Crosby Lockwood & Son, Stationers' Hall Court, Ludgate Hill.

The chief additions and alterations to this well-known work relate to the chapter on dynamo working, which has been largely extended; the chapter contains a useful table relating to the current densities required for working various solutions. The old method of estimating the size of the battery by the "number of gallons of solution" has been abandoned, being extremely misleading; the section on dynamos has been re-written; we note, however, a slight slip where it is stated that "a column of mercury 106 *metres* in length and 1 square millimetre in section offers a resistance of 1 ohm."

Reference Book of Tables and Formulæ for Electric Street Railway Engineers. By E. A. Merrill. New York: W. J. Johnston Company, Limited.

This little book contains little that cannot be found in every engineer's pocket-book, and its title is certainly rather misleading, very little or no special matter concerning electric roads being given. Nothing is said of return circuits, their resistance or durability, or about the wear and tear of trolley wires. Nothing about the units to be adopted in power-houses, the various sizes and connections of motors and dynamos, the average life of the various parts of an electric railway, or depreciation, &c.

Some useful tables are given, such as the various dimensions and weights of car bodies and trucks in use in America, the strains on the poles supporting trolley wires of various spans and with various sags of the wire. Unfortunately for English readers all, or most, of these tables are in the American B. & S. gauge, and therefore of little use on this side of the ocean.

There is little doubt that a really good pocket-book of electric tramway engineering would be very welcome.

CORRESPONDENCE.

The Hermite Process at Worthing.

With reference to Dr. Kelly's report on the above, which you noticed in your last issue, permit us to point out that in our opinion the samples submitted to Drs. Klein and Dupre were not fair samples of the treated sewage, and that our view was supported by several members of the Worthing Town Council at their meeting last Tuesday. As a consequence of this feeling, the Council decided to consider the report as confidential, and not to adopt it or print it until it was confirmed by the investigations now being undertaken by the British Institute of Preventive Medicine. Unfor-

tunately, Dr. Kelly had on his own responsibility allowed a large number of copies of the report to be distributed throughout the country. As you have given publicity to the report, we rely on your sense of fairness to give equal publicity to our protest.

Paterson & Cooper.

April 9th, 1894.

Livet's Steam Generator and Destructor.

I have read your article on the above in your recent issue, and I think you have treated it very harshly and from one point of view. Because the Hopcraft furnace failed to do what was expected of it, it is surely no reason why every other invention should be condemned straight off. This Livet installation has been at work in this town 8 to 10 months, and has been seen and tested by engineers and corporations. You cannot say it has been hid in a corner. Every vestry and corporation in this country has been invited to see it and make their own tests. This installation was built for coal consumption and not refuse burning, so that the width of the grate bars is only 3 feet 6 inches, and not 5 feet or 7 feet, as they could be made when built for refuse burning. The utmost ever got out of a cell in a destructor is 20 H.P., which is very different to the plan shown herewith (per post). I have no doubt whatever that this refuse boiler will have a large future, especially for trades such as cotton spinning, dyeing and chemical plant, and with large users of steam power. In fact, I am daily receiving enquiries for private works, asking for plans, quotations, &c., and if one or two in a trade begin, the rest are bound to follow.

Geo. F. Priestley.

Halifax.

[This letter is referred to in our leader on the subject.—Eds. Elec. Rev.]

The Heilmann Locomotive.

I have read with interest the various editorials and letters which have appeared in your paper concerning the Heilmann locomotive, especially the article in your issue of March 16th, considering it "from an electrical point of view." I notice that in the same issue Mr. Frank B. Lea calls your attention to my patented method of operation, which he speaks of as similar to that of Heilmann.

I invite your intention to what seem to me to be errors in your article in assuming that a turbine is analogous to an electric motor in its operation.

Electric power is the product of the volts and ampères. The energy represented by a moving load is the product of the velocity and the torque. To secure perfect efficiency under all conditions we should always use our electric energy so that our volts will vary as the speed desired, and our ampères as the torque required.

To accomplish this we must vary the volts of our electric energy to vary the speed, and if we use our ampères in a constant field we will have a torque proportional to the ampères, and therefore (disregarding the small fixed losses of the field and the heat losses in the armature), we will have perfect efficiency under all conditions.

To secure a constant field independent of the armature current, we must excite the motor field independently. If we also excite the generator field separately and place in the generator field circuit a reversing rheostat, we can send any desired current around the generator field in either direction, and, hence, can produce in the armature circuit any desired E.M.F. in either direction.

This is my method of regulation, and it presents many advantages over former methods, both as regards efficiency and as regards perfection of control and freedom from sparking.

In a turbine there is nothing analogous to the counter E.M.F. of an electric motor which, considered relatively to the impressed E.M.F., is the measure of its efficiency.

Your remarks are only true when the electric motor is across a constant E.M.F. with a rheostat as the means of controlling the speed.

You say, "In running an electric motor at variable speeds and with frequent starts, we are working it contrary to the laws of nature, and, as a consequence, have to pay the penalty in loss of energy." This is not true if we operate by my method, and vary the volts of the source of supply for the motor armature revolving in a constant field.

If Mr. Heilmann were to use my method of control he could start his tram with but a few horse-power from his steam engine, for, in starting, while he would need a large current to secure the large torque for starting and accelerating the load, this large current would be procured by a very few volts, and the total power in his engine used in starting would not be 10 per cent. of that required for full speed.

To use my method of control we need a generator whose voltage is controllable at will, to supply each motor. We also need motive power at a constant speed with which to drive the generator.

For long distance railway work I propose to use as this source of motive power for the generator a synchronous, single-phase, alternating current motor, a small portion of its current being rectified for supplying its own field and that of the continuous current generator it drives, and also that of the propelling motors.

My method offers a perfect solution of the problem of utilising the energy of retardation in bringing the moving load to rest, as it restores this energy to the supply line until the locomotive is brought to rest. No mechanical brakes are required for normal operation, and the motors may be reversed freely with perfect results.

My method has not been applied to railway work as yet, but has been applied to passenger elevators, mining hoists, large cloth printing machines, travelling cranes, and many other minor uses.

By my method the load diagram of a railway will be as smooth as that of a lighting station, and the efficiency of operation very much increased.

You will find my method fully described and discussed in the February and March, 1894, *Transactions of the American Institute of Electrical Engineers*, under the title "How shall we operate an electric railway extending 100 miles from the power station."

H. Ward Leonard.

LEGAL.

Thompson *v.* Cowles Syndicate, Limited.

In the Court of Appeal on Tuesday, before the Master of the Rolls and Lords Justices A. L. Smith and Davey, the hearing was commenced of an appeal from the judgment in this case delivered by Baron Pollock on November 14th last.

Mr. Fletcher Moulton, Q.C., said the plaintiff, Mr. Thompson, sued the defendant company for the price of certain carbons sold by him to them. The case was heard before Mr. Baron Pollock, who found for the defendants, and he (Mr. Moulton) now appealed against that decision. There was originally in the pleadings a counter-claim, which was abandoned at the hearing, so that the only question before their Lordships was whether the plaintiff was entitled to recover the price of the carbons, the defence being that the carbons were not good carbons. There would be two questions in the case, one as to what the contract was, that is, what liabilities it carried with it; and, secondly, as to whether the alleged breach was proved. The carbons were used in the process of electrically obtaining aluminium; aluminium was got from a certain cryolite and alumina pounded and mixed together, and the carbons were used for passing an electric current into the mixture. This made the materials so hot that they melted. The carbon rods were tied together in bundles and used as conductors to convey the current into the bath and to convey it out again. It seemed to him most important that their Lordships should see the way the contract was made in order to get at an understanding of what it was they really undertook to furnish. They (the plaintiff's side) said that what they furnished were perfectly good. There was no question about their being anything but pure carbons, and there was no warranty of any kind. They were delivered, and the defendants worked with them, but they found that they gave them some trouble, so they did not continue to purchase them, and refused to pay for those which they had purchased.

The Master of the Rolls: What did the judge hold?

Mr. Moulton: That there was no warranty; but it seems to me that he also held that the purpose to which they were to be applied was a known purpose, and that they must be commercially fit for that, and then he held—I think, by mistaking the evidence—that we sent something which was not that which we were supplying to other people for the purpose. We sent them a sample, quoted for carbons according to that sample, and sent carbons exactly like that sample. That is not contested. We sent carbons similar to those supplied to a firm doing the same thing for five years. I submit that the alleged failure was not a failure due to any defect of the carbon at all.

The Master of the Rolls: What did the judge find?

Mr. Moulton: He found that these were not suitable carbons for use in the aluminium process. Continuing, Mr. Moulton read the correspondence between the parties, showing that an offer was made and sample sent in 1891; attention was re-directed to this quotation in May of the following year, and an order was ultimately given.

The Master of the Rolls, quoting a phrase in one of the letters, "of similar make to sample forwarded," said that did not constitute sale by sample.

Mr. Moulton thought it was something very near it. Resuming his argument after the luncheon interval, Mr. Moulton said he would pass on from his first point to the performance of the order. First of all, he would like to make clear a point of which a good deal had been made by the defendants. The plaintiff was the agent for a French manufacturer, M. Berne, to whom the order was passed on. That gentleman wrote saying that 3,000 kilos. of carbon would be sent off in two qualities, so that the Cowles Company might make tests and choose which they preferred, and then the remaining 7,000 kilos. to complete the order would be sent in accordance with their selection. That letter expressed the intention of M. Berne at the time of writing; but, as a matter of fact, only one quality of carbon was sent, and that was the same quality as the sample, and the same as that which had been supplied to the Swiss Aluminium Reduction Company in large quantities. He could not see why so much importance was attached to this letter. It was not as if one quality was to be cheaper than the other, or in any way different from the other, except that one might suit the particular mode of working of a customer better than another. As a matter of fact, however, that intention was not carried out, as would be seen from M. Berne's evidence. Now he came to the complaint against these carbons. From January, 1892, the defendants had been using certain carbons supplied by an American firm, who had, he believed, set up their own plant, and they had had an American expert over, who had arranged the plant and taught them their business, and told them exactly what current to send through these American carbons. He thought it was 141 ampères that was sent through each carbon. They had never had any experience of anything but these American carbons, which were very hard and metallic in ring. He did not know how those carbons were made—that was a secret, he supposed. He ought to explain that when the two things, cryolite and alumina, were put together, a current was passed into the mass until it melted, when a twofold action took place. The action was partly electrical, tearing apart the alumina and the oxygen, and partly chemical, the oxygen when it was torn away from the alumina attacking the carbon and uniting with it, forming carbonic acid or some other gas, perhaps carbonic oxide, and there was no more oxygen there for the alumina to take up, for at the high temperature of the bath the carbon had a fiercer appetite for oxygen than even aluminium. So that these sticks of carbon wasted, and ought to waste, because they were partly doing the work by being burnt up, that was, by supplying the carbon which mixed with the oxygen that was driven out, and rose up, and was got rid of.

Lord Justice A. L. Smith: What do they put the carbons into?

Mr. Moulton said something like a small cistern lined with carbon blocks to stand the immense heat. They crushed the cryolite and the alumina into a fine powder, and made the bath with the mixture. Then they put the bundles of carbon in and passed a very heavy current through, and the tremendous resistance of the stuff in the bath developed tremendous heat, and that melted everything. As soon as it was melted the resistance grew less, and a larger current passed through. The secret of the process was that the oxygen attacked the carbon of the electrolyte, and got turned into a gas which passed away, and thus they got aluminium in a metallic state without its recombining with oxygen. It was said that the American carbons remained black above the bath, whilst when the plaintiff's carbons were used they got red hot, and wasting set in. They took the plaintiff's carbons and used them with the same current as they had been using for the American carbons, making no experiments to find what was the proper composition of the bath, or what was the proper current to send through them; they just did the same as they had done with the American carbons. What happened was this: plaintiff's carbon got tremendously hot, so hot that they wasted away, because the air attacked them. They carried out the process in an open cistern, instead of covering in the cistern to exclude the air, and so prevent the wasting. The defendants said, "What your carbons did not do the American carbons did, and therefore yours are bad, and the Americans are good."

The Master of the Rolls: Were yours cheaper than the American?

Mr. Moulton believed they were a little dearer. Plaintiff replied, "It does not follow at all that ours were worse carbons than the American." There were only about four people in the world who did this difficult process, so that there was no "ordinary method" in the usual sense, and the best way of using particular carbons could only be determined by experiment. The plaintiff's contention was that they must have had the bath a great deal hotter when his carbons were used than when the American carbons were used; they must have done so from the very fact that in one case the carbons remained black, whereas in the other they got red hot, for they had ascertained that their carbons were quite capable of withstanding the current of 43 ampères said to have been used, without getting even too hot to hold in the hand. Therefore the failure was from no fault of the carbons. It might, indeed, be because the carbons were too good. The action might have been too energetic in the bath, and too much heat might have been generated. They said they sent the same current through for both.

Lord Justice Davey: You say they ought to have used a current adapted to the particular carbon; that they ought to have found out what was the right current for that particular kind of carbon?

Mr. Moulton: That is my point, my lord.

Lord Justice A. L. Smith: Suppose 142 ampères did not make one kind of carbon red, but left it black, whilst the same current made the other red hot?

Mr. Moulton: If the 142 ampères going through our carbons would have made them red, apart from the condition of the bath, then it might be that ours would be very much inferior for that purpose, because you could not pass so big a current through. But it was calculated and proved that you could send 142 ampères through our carbons for ever, and they would not get too hot to put your hand on—would not get above 90°. So that, broadly speaking, the whole of the heat came from the bath. What made the bath hotter in one case than in the other he could not say. But, whatever it was, it could not be the fault of the carbons. At Neuhausen they experimented for two years to find out the right conditions for working. This was not a thing a child could do; a very little thing might throw the whole thing out. They did not profess to know what the process was that the defendants were using; at first they thought it was the Cowles process, but they learnt afterwards that it was not.

Lord Justice A. L. Smith: You must admit there was the bargain to supply carbons for smelting.

Mr. Moulton: Carbon electrodes, I quite agree. But these are only big sticks of well-made carbon. You may use them in any way you like. They are sometimes used for the Cowles process.

The Master of the Rolls: You must have known the particular purpose for which they were required.

Mr. Moulton: We did; so much so, that these were the things which we used to supply to the Swiss Company for the same purpose.

The Master of the Rolls: It seems to me that you did not warrant at all that they should answer a particular purpose, but you did that they should be a merchantable article.

Mr. Moulton: Certainly.

The Master of the Rolls: The judge seems to have put you in the most favourable position as regards the contract, but to have found that you supplied articles which were not merchantable.

Mr. Moulton: That they are merchantable carbon rods for use as electrodes in smelting there is no doubt. The only evidence of inferiority, and the only evidence at all of their not being merchantable, is the failure, without previous experiment of any kind.

The Master of the Rolls: I am inclined to think you should have been on the higher ground, that you knew the purpose, and therefore undertook that they should be suitable for the purpose. Therefore, if they would not fulfil that purpose, although they might fulfil some other, you failed.

Mr. Moulton: It appears to me that they have got to show that they could not use them for the purpose at all, not that when used under particular circumstances they failed. The carbons, Mr. Moulton continued, were perfectly good, pure carbons; he was quite willing that specimens should be sent to any electrical expert of eminence to decide whether they were good carbons or not.

The Court then rose for the day.

When the Court resumed on Wednesday morning, after a brief consultation between the parties,

Mr. Fletcher Moulton said: My friend (Mr. Bousfield) and myself have considered this matter, and have arrived at a settlement.

The Master of the Rolls: Then what becomes of the appeal?

Mr. Moulton: The appeal is settled in the terms. The appeal is withdrawn.

BUSINESS NOTICES, &c.

The Universal Electrical Directory (J. A. Berly's) for 1894.—Published by H. Alabaster, Gatehouse & Co., 22, Paternoster Row, London, E.C. This directory comprises the names of 18,414 different individuals and firms, is divided into four sections, namely, British, Continental, American and Colonial, each of these being sub-divided into alphabetical and classified sections. There are about 800 pages consisting entirely of directory matter, making the book the fullest, as it is the oldest, electrical directory in the world. The price of the work is 4s., post free.

Chadwick v. Woking Electric Supply Company, Limited.—On Saturday last Mr. Justice Stirling, sitting in the Chancery Division of the High Court, heard counsel (Mr. Beckett Terrell), upon a motion for judgment in this case. Mr. Terrell said this was an action by debenture holders to realise their security, and the defendant company did not enter an appearance. Judgment was accordingly asked on the statement of claim. In January, 1891, 60 debentures of £50 each were issued, charged on all the assets of the company. The principal was to become payable at a particular date; or, if there was default, as had happened, of payment of interest for six months, the debentures were to fall in. By a subsequent agreement, these debenture holders agreed to postpone their security to enable other debentures to be issued in priority, and six debentures of £500 each had been issued, and there was also default upon them. These debentures were in the hands of Mr. Chadwick at the date of his death, and this action was brought by his legal representative. He asked an account of what was due, distinguishing between the holders of the six debentures and of the 60. His Lordship asked why it was desired to distinguish between them. Mr. Terrell replied that they did not stand *pari passu*, the 60 having postponed their security to the six. His Lordship: Had you not better put it, "An account of what is due and what is the priority." Mr. Terrell assented; he added that the Receiver, who had been appointed in the action, had entered into a provisional contract with certain persons for the sale of the whole business as a going concern, but that would be subject to approval in Chambers. His Lordship accordingly gave liberty to apply in Chambers as to the realisation of the property.

The Electric Light at Londonderry. — On Friday evening a special meeting of the Lighting Committee of the Corporation was summoned for half-past seven o'clock "to consider a communication from Messrs. Siemens Bros. & Co., Limited, intimating that they cannot take the responsibility of running the electric lamps in face of the resolution of the Lighting Committee." The chairman then requested Mr. William Stafford to read the resolution of the Corporation passed at a previous meeting, which was as follows:—"That until Mr. Blake has certified that the doors and locks of the lamp pillars are all in proper order the Corporation disapproves of the electric current being passed through them." Alderman Fleming thought that resolution should never have been passed. At the same time, he thought Mr. Blake should see to it at once that the doors and locks were above suspicion. The chairman then read a telegram addressed to Mr. Nuttall, Messrs. Siemens's representative, which was as follows:—"In view of Council's resolution we cannot take responsibility of running lamps. Do not run them again until locks are right or Council makes proper provision against accident and sanctions our running. Point out that this delays our contract." Mr. Thompson wished an explanation of the meaning of the telegram, seeing the Corporation had not yet taken over the electric light from Messrs. Siemens Bros., who were in charge and still responsible. The chairman said the contractors were bound by the terms of their contract to hold the Corporation free from all claims for loss occasioned by neglect or carelessness, and generally until the completion of the contract, and all care and risk were theirs, so that there was no necessity to pass the resolution at all. A lengthened and animated discussion then followed with reference to bad locks and ill-fitting doors in the lamp pillars. On one night thirteen doors were reported to have been found open. Mr. Nuttall explained that his firm was only responsible for part of the work, and could not be held responsible for any deficiency in the locks or pillars supplied to the Corporation by Messrs. Brown & Sons, and, hence, the telegram from his firm. Messrs. David and John Brown expressed their readiness to make good any deficiency in the locks or doors that might be reported to them. They denied that their locks were "shoddy" locks, as had been reported, and thought it would be unreasonable to ask them to repair locks that had been broken open with iron crowbars. With regard to the doors, it was stated that these were all properly fitted before leaving the works, but might have got injured afterwards. Mr. Blake said several of the locks were badly fitted, but he considered the mechanism was good. The chairman said some of the doors would require to be recast, and, in some cases, the brass hinges were projecting beyond the level of the pillar. Mr. Greer warned the committee to be most careful not to take over the electric system until it was perfect in every respect, lest they might have a few inquests. Mr. Christie, in reply to Councillor Turner, admitted that the locks of the pillars had often been tampered with in Glasgow, and the same nuisance of opening the doors had to be contended with there. A motion by Mr. Pollock, practically confirming the resolution on the books, was moved and seconded, and an amendment to adjourn *sine die* was put to the meeting, but was ruled out of order on a point raised by Councillor Thompson that the resolution already passed required to be rescinded before any other resolution could be moved. The members then separated, the chairman remarking that, as everything had been explained and agreed to, there was no need for any adjournment.

Chloride Accumulators.—From the Chloride Electrical Storage Syndicate we have received a catalogue, dated 1894, of the chloride accumulators. The pamphlet, which has been elaborately prepared in regard to quality of paper and style of printing, sets forth the advantages gained by the use of these accumulators, quoting in detail as an instance, the Paris and St. Denis Electrical Tramway, on which the chloride electrical accumulators supply the power. After describing in general the accumulator, a table is given of the specific resistance of sulphuric acid solutions. Following this are other tabular statements giving particulars and prices of cells fitted with the standard "S" type plates. There are also given prices of plates for renewal, prices of special protected type accumulators, "S P" type cells, particulars of batteries of cells with accessories for incandescent lighting. We are informed that considerable misunderstanding has arisen in regard to these batteries, as, owing to the name of the company, many people have thought that chlorine gas would be given off. Such is not the case; the word "chloride" is merely derived from the process of manufacture; when the battery is ready for action there are no chlorides working.

Guildford and Electric Lighting.—In pursuance of the resolution of the Corporation, the Mayor and the Town Clerk attended on Saturday before the Board of Trade in reference to the introduction of the electric light into Guildford, and the provisional order applied for by the Holloway Electric Supply Company. The promoters, who are Messrs. Sharp & Kent, were also represented at the interview, which was only of short duration. After a little discussion the Board of Trade intimated that they would dispense with the consent of the Corporation to the order, and if the Corporation wished to have any clause inserted whereby they could acquire the undertaking on terms before the expiration of the period inserted in the order (42 years) the Board would give the matter their consideration on hearing from them.

We understand that at the debate of the Town Council on Tuesday night, it was decided to make a request to the Board of Trade to reduce the period at which they might purchase the undertaking *on statutory terms* from 42 to 30 years.

South Shields Electric Lighting.—The Town Council have adopted an agreement with Mr. Wm. Black for the purchase of his freehold property at the Low foundry, West Holborn, containing 2,506 yards for the sum of £4,400.

Worcester Electric Lighting.—The council have resolved to rescind a resolution passed last year, to erect at the waterworks a small pair of Tangye's engines and pumps, estimated to cost £910, and two Galloway steel boilers, estimated to cost £1,050, and they have decided, in lieu thereof, on the acceptance of the tender of the Brush Electrical Engineering Company, Limited, to supply and fix two sets of electrical pumping plant, consisting of two alternating current motors of 30 brake horse-power (an efficiency in the motors of 90 per cent. to be guaranteed), and two three-throw pumps capable of delivering 10,000 gallons per hour to an elevation of 300 feet through 5,000 yards of 10-inch main, at an estimated cost of £1,128, and also to lay an electricity main capable of conveying a current sufficient to drive the motors and light 1,000 lamps *en route* from Castle Street (where the main already ordered will terminate) to the waterworks, at an estimated cost of £961, making a total estimated cost of £2,089.

Electric Pumping Plant.—A trial was made in the works of Messrs. Ernest Scott & Mountain, The Close, Newcastle-on-Tyne, on Saturday last, of two sets of large electrically driven pumps in course of construction for the Lothian Coal Company, Newbattle Collieries, Dalkeith, N.B. The trial was witnessed by a large number of leading engineers of the district, as well as a number of others interested in collieries and electrical matters, from a distance. The trial proved very successful, and as this is probably the largest pumping plant that has ever been put into a colliery, electrically driven, it was of more than general interest.

Bedford Electric Lighting.—The local authority held its meeting on Monday to consider what course it would take, following the order of the Board of Trade in regard to the electric lighting question to which we referred in these columns last week. After a very lengthy discussion it was resolved by a majority of three votes to keep the electric lighting powers in their own hands, and to carry out the necessary work before January 1st, 1895. An amendment demanding a poll of the inhabitants was lost. A further motion giving the electric lighting committee power to appoint an engineer and carry out the work, was also carried.

Bankruptcy.—Lord Thurlow, a few days ago, attended for preliminary examination under a receiving order recently made against him. He is described as of Chesham Place, and carrying on business at Tokenhouse Buildings, City. He states that the offices in Tokenhouse Buildings are not his, but belong to companies with which he is connected. He resided at Chesham Place until November last, when the furniture there was seized and sold by the sheriff under an execution. His assets consist chiefly of shares and debentures, which are stated to be charged. The amount of the liabilities does not appear.

Electrical Exhibition. — An exhibition of electrical cooking and heating arranged by Messrs. Habgood & Smith, of 49, Queen Victoria Street, E.C., and Great Missenden, was held at the latter village on April 4th and 5th, the apparatus, which consisted of ovens, frying pans, kettles, flat-irons, &c., being lent by Messrs. Crompton & Co., Limited. Mr. Habgood gave a short introductory lecture on the application of electricity to heating purposes. The lighting of the village is still progressing favourably, and is being well taken up by private consumers.

Bowker Bros.—In last week's issue, in our notice regarding the tenders for lighting the United Methodist Chapel, Blackpool, the tender of Messrs. Bowker Bros. is given under the heading *without* electroliers. This, however, appears to be incorrect, as Messrs. Bowker's estimate includes their patent safety electroliers. The firm have supplied one of their patent electroliers of 33 lights, which is placed in the centre of the Grand Hall of the Cannon Street Hotel, London.

Electric Cooking.—Messrs. Crompton & Co., Limited, gave, yesterday, an exhibition of electrical cooking and heating apparatus at Belgrave Mansions, Ebury Street, S.W., the showroom of the London Electric Supply Corporation, from whose station at Deptford the current is supplied. Demonstrations will be given every Thursday from 3.30 p.m. to 5.0 p.m., admission being obtained by presentation of visiting card.

Appointments.—Mr. W. E. Clarke has been appointed assistant electrical engineer at the *Daily News* installation, Bouverie Street. He qualified himself for the appointment under Mr. Ronald A. Scott, M.I.E.E., at Acton Hill Electrical Engineering Works, London, W.

Mr. Harold W. Couzens has, this week, been appointed electrician in charge at the Taunton works at a salary of £120 a year.

Private Installations.—Messrs. Rashleigh Phipps and Co. have received instructions for the electric lighting of Mr. George Grossmith's house in Dorset Square, which has to be completed within a fortnight. This firm is also engaged upon the electric lighting of Earl Fingall's house in South Audley Street, as well as a complete plant at Mr. Netlam Rattray's mansion at Bear Hill, Twyford.

The Electric Lighting of Edinburgh.—A meeting of the proprietors and tenants of property situated in George Street, Charlotte Square, St. Andrew Square and streets leading thereto from Princes Street, was held in Dowell's Rooms last week. The object of the meeting was to protest against the action of the Town Council in excluding George Street, St. Andrew Square, and the adjacent streets from the benefits of the proposed street electric lighting.

Personal.—The address of Mr. Arthur C. F. Webb, M.I.E.E., in future, will be Post Office Chambers, Pitt Street, Sydney, N.S.W.

Woking Electric Lighting.—Messrs. New & Mayne have obtained complete control of the Woking Electric Supply Company, and are making such alterations and improvements to the plant as will enable them to increase the output of the station considerably. At the present time there are some 3,500 lights connected, and there is every prospect of greatly and rapidly adding to these. The chief alterations now being made are in the direction of reducing the coal consumption, running the machines synchronously, and automatically switching on and off the primaries of the single transformers for load and no load, as also in the cases where two or more transformers are running in parallel. This latter improvement the firm are now able to make by means of their patent automatic transformer switch, a notice of which appeared in our columns some time back. There are already laid some 10 miles of cables which cover a large district, many extensions to these are now being carried out.

Mansion Electric Lighting.—A considerable amount of work is being carried out at Derby House, the London residence of the Earl of Derby, which is being decorated throughout, and the electric light is being fitted in every department. All the reception rooms are to be lit with shaded lights alone. The number of lights being arranged for is about 400.

School Electric Lighting.—The new schools of the Mercer's Company, Barnards Inn, Holborn, are to be lit with the electric light. Specifications and plans for a very complete system of wiring have been drawn up by Messrs. Shepherd & Wabury, consulting engineers, Leeds, and the contract has been let to Messrs. Strode & Co., at £537.

C. H. Cathcart & Co.—We are informed that Mr. Cathcart, late partner in the firm of Cathcart, Peto & Radford, has commenced business under the above title, and has opened offices and works at 4, Dorset Buildings, Salisbury Square, Fleet Street, E.C., to which address all business communications should in future be sent.

Middlesbrough Proposed Electric Lighting.—The Electric Lighting Committee of the Town Council have appointed a deputation to visit Halifax and Bradford (also Huddersfield, if thought advisable), to inspect the electric lighting plant laid down there, and to obtain information generally as to electric lighting.

Price List.—From Messrs. Lea, Sons & Co., of Shrewsbury, we have received a specimen sheet of their art metal work manufactures.

Keighley and Electric Lighting.—The Town Council propose to apply, in the coming session, for a provisional order for lighting the town.

CONTRACTS OPEN AND CLOSED.

OPEN.

Denbigh.—For the construction and maintenance for a period of five years of a telephone between the asylum and Glanywern Hall, a distance of about three miles, for the visitors of North Wales Counties Lunatic Asylum. Further particulars may be obtained from Mr. Wm. Barker, clerk to the visitors, Denbigh.

Edinburgh.—April 17th. The time for sending in tenders for the erection of central station buildings has been extended to April 17th.

Emsworth (Hants).—April 26th. For the lighting of the public lamps for one year, commencing July 22nd, 1894, to July 21st, 1895, for the inspectors of lighting. Tenders will be considered at the meeting of the inspectors to be held on May 7th, and should be delivered to Mr. J. W. Loader Cooper, clerk, Queen Street, Emsworth, by 26th inst.

CLOSED.

Bury (Lancs.).—For the supply of electric light fittings, including switchboards, lamps, wiring, &c., for lighting the technical school now in course of construction in Broad Street, Bury, for the Technical School Committee of the Corporation. The tender of Mr. S. H. Heywood, of Manchester, was accepted. The following firms also tendered:—Dugdill & Co., Failsworth; Moorhouse & Son, Burnley; E. Dewhurst, Preston; Northern Counties Company, Manchester; J. H. Hindle, Bury; Doninson, Parmiter & Co., Manchester; Corlett Engineering Company, Wigan; Barnett & Co., Newcastle; Laing, Wharton & Down, London; Manchester-Edison Company, Manchester; Bury & Pope, Burnley; J. Faulkner, Manchester; T. Barton, Blackburn; Drake & Gorham, Manchester; Lowcock, Hill and Co., Manchester; Graham & Biddle, London; Strode & Co., London; Andrews & Co., London; H. A. Clegg & Co., Manchester.

Edinburgh Electric Lighting.—The Electric Lighting Sub-Committee of the Edinburgh Town Council has arranged for supplies of cables from the following contractors:—

Unarmoured cable, Henley's Telegraph Works Company, Limited;
Arc lighting cable, India-Rubber Works Company, Silvertown;
Armoured cable, Siemens Brothers, London.

FORTHCOMING EVENTS.

Friday, April 13th.—Royal Institution. Evening discourse on "Some Properties of the Electric Discharge through Gases," by Prof. J. J. Thomson, F R S. 9 p m.

Friday, April 13th.—Physical Society. "The Mechanism of Electrical Conduction," by C. V. Burton, 5 p.m.

Friday, April 13th.—Junior Engineering Society. Ordinary meeting at Westminster Palace Hotel. "Lubricants, their Use, Testing, and Analysis," by William F. E. Seymour, 8 p.m.

Monday, April 16th.—Third and last lecture on "Photometry," at Society of Arts, by Captain W. De W. Abney.

Tuesday, April 17th.—Royal Institution, at 3 p m. Third lecture on "Electric Illumination," by Prof. Fleming.

Thursday, April 19th.—Institution of Mechanical Engineers. A paper will be read on "A Description of the Grafton High Speed Steam Engine," by Mr. Edward W. Anderson.

Friday, April 20th.—The Institution of Electrical Engineers. Students' meeting at 28, Victoria Street, S.W. A paper will be read on "Secondary Batteries," by G. C. Allingham, 8 p.m.

NOTES.

Expiry of the Patent for the Pilsen Lamp.—The original patent, dated April 6th, 1880, and numbered 1,397, granted as a communication from Messrs. Krizik and Piette, of Pilsen, expired last week. This patent describes both the single-cored double-tapered form of lamp, which was the one most familiar to us; it also describes the focussing type, in which two half-taper cores are used, each carrying a carbon, and moving each within one of the solenoids. This latter type has now become common on the Continent, and now that this patent has expired, it will no doubt be vigorously pushed in this country. Curiously enough, although the specification clearly describes the arrangement with two half-taper cores, each carrying a carbon-holder, and connected by gearing so as to be focussing, this form was not claimed by the patent; and yet this type has proved the best in practice, if we judge by the comparative numbers used. Both forms are specified in this patent, so that now both of them—the double-tapered core and the two separate half-taper cores—in solenoids, are now public property. Improvements on this lamp may now be looked for, as it should be not only a cheap, but a very good working lamp, if made accurately, and designed by an engineer expert in arc lamp design. An excellent design of Pilsen lamp was shown at the World's Fair, and described by us in our articles relating to the exhibition.

Electricity and Town Refuse.—Mr. W. A. Martin sent the following letter on this subject to last week's *Engineer*:—"The remarks under the above head in your last week's issue are deserving of attention. The difficulty up to the present has been how to dispose of town refuse; it is not like coals that can be burnt under a boiler, as there is no power in it; it is rubbish, and must be treated as such. No regular service can be obtained from it; to get an idea one must visit a London dust-yard and witness the heaps waiting to be dealt with. Women are mostly employed in sorting. Ashes form but a part. It is impossible to say what the heaps contain, for every cartload varies. The only practical way of dealing with it in London is to pass it through a destructor, and even these have given offence; the stench from the old destructors on the Albert Embankment extended for two miles. I was asked to undertake the construction of new destructors that would consume smell as well as refuse. This caused me to examine into the nature of the materials to be dealt with. I found that it only contained sufficient power to burn itself when put into the furnace in large quantities, as much goes in that is not burnable, and sometimes damp. The heat from the destructors is not suitable for steam boilers, as the gases evolved are very destructive to iron. It might not be impossible to work a steam boiler with it by selecting clean portions that would burn, but it would be the most expensive system that could be employed, and the most uncertain for electric lighting purposes."

Folkestone Electric Lighting.—The Corporation last week approved of the scheme for the installation of electric light at a cost of £35,000, by a majority of nine to five votes.

South Shields and Electric Lighting.—Since the appointment of Mr. J. A. Jeckell as borough electrical engineer, in November, 1893, the Electric Lighting Committee have had in hand the question of a suitable site for the central station, and after some ten different sites had been carefully considered, they reported in favour of one known as the Low Foundry, which site the Council, on April 4th, agreed to purchase for the sum of £4,400. The site in question is an excellent one, as being on the river, with a frontage of 125 feet, coal can be obtained at the lowest figure, and water for condensing will cost but little, as at low tide the water does not leave the quay. The site has an area of 2,500 square yards, and is very central as regards the whole of the Borough of South Shields.

Electric Light in India.—From the *Indian Engineer* we observe that the Crawford Markets are to be lighted by electricity by the municipal authorities at an expenditure of Rs. 20,000. This, says our contemporary, is a step in the right direction. "The 'Silvertown' dynamo and fittings have been decided upon, and ample power is already available. When the new and lordly home of the City Fathers was in course of erection an electric lighting installation was decided upon. A sum was sanctioned for this purpose, and the generating plant, consisting of a Thomson-Houston alternating current dynamo driven by a 25 horse-power compound semi-fixed engine, was housed in the workshop compound. All this was done, and everything arranged for working, when a section of the municipal body, believing, apparently, that sufficient had been done in the cause of progress, vetoed the application for funds necessary to work the plant, which has consequently been lying fallow since its completion and trial. The 'Silvertown' dynamo is to be driven by the engine already referred to, which is sufficiently powerful to drive both plants. Possibly, when the benefits of adequately lighting the markets are brought home to those in office, the economists may see the error of their ways, and allow a sufficient sum to be set aside for the regular supply of the only illuminant worthy of being used in a building of such importance as the new Municipal Offices."

Modern Currents.—At a recent meeting of the Brighton and Sussex Medico-Chirurgical Society, Dr. Hedley gave a demonstration of "Modern Currents." Currents of "high frequency and potential" were first shown. On connecting up a 5 candle-power lamp with the terminals of the secondary of the oil-immersed coil, the filament was brought to a bright red, and on putting the body also into circuit the glow continued with a slightly diminished brightness. Using half-a-crown as an electrode, no pain or sensation was perceptible, but this was not quite the case on passing the current into the body through a threepenny piece. This shows that current density to some extent enters into the question. Probably both harmlessness and painlessness may to a large extent be dependent not only on rapidity of alternation but on the diminution of current strength that must have occurred by the initial energy having been "transformed up," and though the voltage was high there was very little current strength behind it. There would soon be opportunities of verifying in practice the physiological effects claimed to have been produced on subjecting the body to rapidly alternating "electrostatic stresses." The powerful muscular contractions and other effects produced almost painlessly by the "static induced" current from an influence machine were then shown. With reference to the "sinusoidal" current, which was probably destined to be one of the medical currents of the immediate future, he regretted that he had no apparatus there to show the meeting, but he had in daily use an installation from an alternating light circuit which supplied currents of this order, and which he would be glad to show to anyone interested. He then adverted to tabulated results which showed how such diseases as gout, chronic rheumatism, obesity, diabetes, dyspepsia, rheumatoid arthritis, and sciatica, had been treated by these "currents from the main," administered in various ways by means of the water bath.

Post Office Telegraphs.—An account has just been issued as a Parliamentary paper showing the gross amounts received and expended in respect of the telegraph service from the transfer of the telegraphs to the State to March 31st, 1893. From this it appears that in the period named the total receipts have amounted to £37,912,272, and the total expenditure to £38,421,978, being a loss of £509,706.

The City Commissioners and Failure of Electric Light.—At the meeting of the Commissioners of Sewers held last week, Mr. B. Turner called attention to a serious failure in the electric light. Mr. Ross (assistant engineer) stated that on the subject of the failure he had received a report from the electric lighting company to the effect that it was due to a damaged and defective cable, which, however, was speedily repaired. Mr. Turner hoped the engineer would impress upon the company the necessity for preventing, if possible, such failures in the future. Mr. Turner also complained that the company monopolised the pavements and various open spaces in the City with their materials to such an extent as to become an absolute scandal.

Obituary.—We regret to announce the death, at a comparatively early age, of M. Paul Jablochkoff. Born in September, 1847, at Serdobsk (Russia), he was, at the time of his decease, in his 47th year. After five years of military service, M. Jablochkoff at 24 years of age, through the knowledge he possessed of electricity, attracted the attention of his superiors, who appointed him Director-General of the Moscow-Koursk telegraph lines. While holding this position he took greater interest in the subject of electric lighting. The frequent failures of the primitive arc lighting apparatus then employed induced him to devote his energies to the purpose of effecting improvements in same. Quitting the telegraphic service in 1875, he from that time considered exclusively scientific questions. The year following his vacation of the telegraph service he represented M. Bréguet at an exhibition of scientific apparatus being held in London. Returning to Paris, he worked experimentally in the workshops of M. Bréguet, and after eight months succeeded in perfecting the famous candle which bears his name. In 1878 the Avenue de l'Opéra at Paris was illuminated by a magnificent row of these candles, and shortly afterwards they were in use in Rome and London. M. Jablochkoff's name is also attached to a variety of patents for electrical inventions, among them may be mentioned electrical distribution, incandescent kaolin lamp, alternate current dynamo, sodium battery, and auto-accumulators. Major Flood Page, in the columns of the *Times*, pays the following touching tribute to the memory of the late Russian scientist:—"There is no doubt that he did a great deal in directing the attention of the very small body of electricians in 1876-77 to the practicability of electric lighting, and much credit is due to him for his original work and for the advance he made. For some time his electric candle held its own, and was undoubtedly the best system then in existence; it is still in use in Indian mills and many other places. In spite of the fact that he was supported in St. Petersburg by an illustrious personage, this clever Russian officer was not a successful man, as we men count success. Nevertheless, that St. Petersburg, which was behind the other capitals in the use of gas, and Moscow, which was not lighted by gas till 1866, have their central electric stations, and palaces, houses, and streets electrically lighted, is in no small measure due to the interest taken in them by M. Jablochkoff, and the impetus given to electrical advance in Russia by his original work. Like many inventors he was very sanguine, and was, I am afraid, a very disappointed man; his works at St. Petersburg were large and well planned, but when, some years ago, I saw them, he was working hopefully and bravely, but under financial and other difficulties. It can hardly be denied that M. Jablochkoff was one of the ablest and most original of the band of practical electrical pioneers."

We also regret to announce the death of Mr. Theodore Holmes, the second in age of the five brothers, who with their senior Mr. W. H. Holmes, comprised the members of the firm of J. H. Holmes & Co. His death occurred on April 5th of typhoid fever at Kioto, whilst travelling in Japan.

The Telephone at Bristol.—The number of subscribers to the National Telephone Company's system at Bristol is increasing. At the end of 1891 the subscribers were 562; 1892, 609; 1893, 767; and at the present time nearly 800. There are, in addition, about 200 private lines.

Presentation.—On Saturday last a complimentary dinner was held at the Imperial Hotel, Brighton, in honour of Mr. G. J. Philpott, the chief engineer of the Brighton and Hove Electric Light Company, who is just relinquishing his position with the company. A gold watch and chain was presented to Mr. Philpott as a parting gift.

Changes in the Electric Construction Company.—There are, it seems, extensive alterations being effected at the Bushbury works of the Electric Construction Company, especially in regard to the members of the staff. A number of the officials and workmen met last week for the purpose of bidding farewell to several members of the staff, *i.e.*, Messrs. J. H. Woodward, E. S. G. Rees, C. H. Iles, and W. Armistead. Mr. Thomas Parker was in the chair, and made one of his characteristically amiable and enthusiastic speeches. To each of the four gentlemen referred to was presented an address, and an album containing a number of photographs, and 180 signatures. A few days afterwards Mr. E. S. W. Moore also severed his connection with the Electric Construction Company, and was presented with a gold sovereign purse by some of his friends at the works. Mr. Thomas Parker has also severed his connection with the Electric Construction Company.

Telephone Strike in Paris.—The members of the Paris Stock Exchange who use the telephones for communicating with London, Brussels, and the provinces have been in the habit of settling their telephone accounts at the Bourse at three o'clock. Last week they were surprised to be called upon to pay for their communications before they were allowed to enter the telephone-box. They were also told that they would have to declare beforehand whether they required one or two conversations, and to pay accordingly. The indignant members of the Stock Exchange held a meeting on the steps of the Bourse, and decided that they would not use the telephones until the vexatious regulations adopted by the authorities were withdrawn. From mid-day until two o'clock the long-distance telephones were at a standstill, when it was officially announced that the telephone authorities had withdrawn the orders that had given umbrage, and peace was restored.

Telephones and Lightning.—Mr. Soulby, who contributed an article to the Review last week on a new diaphragm, gives in a recent issue of the *Manchester Courier* a rather alarming experience of lightning:—"As a warning to users of telephones during thunderstorms, I record the lively performances of one in my office this afternoon during the progress of a very severe storm. As the electrical disturbance gradually approached, every flash rattled the platinum connection against the diaphragm of the transmitter, lighting up the latter and ringing the bell. As the storm came nearer sparks passed from the receiver, hanging on its hook, to the diaphragm of the transmitter with a sharp crackling sound. I then removed the receiver from its hook and placed it on the window sill to observe the effects on its diaphragm, but beyond a "clacking" sound and a momentary lighting up of the diaphragm of both receiver and transmitter, nothing special occurred. I now hung the receiver on its hook again just as the storm was at its height, and in a few minutes a tremendous flash occurred, sending a shower of sparks from the receiver to the transmitter, and to the several metallic parts of the telephone, including the bell connections, such as would have proved fatal to the hearing, if not to the life, of any listener. The distance from receiver to transmitter was just 5 inches, the discharge dividing into numerous branches, each line of sparks trying to find a suitable conductor to make the earth connections. The minimum electromotive force required to produce a spark 5 inches long through dry air can be easily given, but the actual E.M.F. in the above instance cannot be estimated to a few thousand volts. Therefore, beware of the 'receiver' during a thunderstorm at either end of the line of communication."

Personal.—Mr. A. J. Lawson, M.Inst.E.E., has been appointed engineer and manager of the County of London and Brush Provincial Electric Lighting Company.

Yarmouth and Electric Lighting.—A committee has been appointed to consider the present lighting of St. Andrew's Ward, and to report as to whether any improvement could be obtained in the quality and cost of the gas supplied. The Electric Lighting Committee have also been invited to make a report.

Exhibition at Buda-Pesth.—The Department of Science and Art has received, through the Foreign Office, a despatch from her Majesty's Consul-General at Buda-Pesth, calling attention to an exhibition of electrical machine tools, which it is proposed to hold there from May 27th to September 30th next.

Patent Office Free Library.—We are desired by the Librarian to state that this library is open free from 10 a.m. to 10 p.m. every week-day. The library contains English, Colonial, and Foreign specifications and trade marks; text-books, periodicals, &c., in all branches of science, English and Foreign.

Explosion at Nantes.—On Wednesday last week great alarm was occasioned at Nantes at half-past eight at night by several loud reports, followed by the sudden upheaval of the pavement in the Place du Pilori for a distance of over 40 yards. Three pedestrians were injured, one rather seriously. An investigation showed that a serious explosion had occurred in the electric light and gas main, and it is believed that the accident was caused by an electric wire coming into contact with a gas pipe.

Hermite Process.—The following is a copy of a letter sent by Mr. R. A. Cripps, F.I.C., to the *Worthing Intelligencer*: "I see from the report in this day's *West Sussex Gazette* that the Town Council has decided not to publish Dr. Kelly's report on the Hermite system of sewage treatment until the reports of Sir Henry Roscoe and others have been received. Judging from the results I have obtained, this decision is a wise one, for there is reason to think that Dr. Goldsmith's remarks on the unrepresentative nature of the samples are of the utmost importance. My own experiments are, from various reasons, incomplete, the bacteriological tests having alone been carried out, but so far as I have gone, the results are distinctly at variance with those of Dr. Klein, and indicate that Mr. Hermite's claim for complete sterilisation is founded upon fact. I should not have 'rushed into print' at this stage of the examinations were it not that I feel justice to the inventor demands prompt publication."

The Telephone in England and America.—A German contemporary, in publishing Mr. W. H. Preece's comparative tables, showing the use of telephones in British and American cities, adds a table of its own, setting forth the number of telephone subscribers in the principal German cities. In Berlin, for instance, there are more telephone subscribers than in New York and Chicago combined, the exact figures being 20,344 for the German capital, and 9,066 and 9,684, respectively, for the American cities. The proportion to population is one subscriber to 78·4 inhabitants in Berlin; one to 114 in Chicago, and one to 167 in New York. In Hamburgh, a city about the size of Cincinnati, there are 8,026 telephone subscribers, the proportion to population being one to 40·8. This proportion is not equalled by any American city given in Mr. Preece's table, the nearest approach to it being Providence—a much smaller town—which has a telephone for every 45 inhabitants. The English show up very poorly in comparison with either Germany or the United States. London has no less than 636·3 inhabitants for every telephone subscriber, and in all the other British cities mentioned the proportion is high, except in Liverpool, where it is just about the same as in Chicago. The *Western Electrician* considers that the Berlin contemporary referred to is amply justified in its conclusion that "the showing in some of the German cities is very favourable, while that of England is very poor indeed."

Ayr and Electric Lighting.—A report read at the Town Council meeting last Monday stated that steam plant for an electric installation for Ayr would cost £11,000. The cost for 16-candle light was estimated at 12s. 10d. for 500 hours' burning, as against 8s. 4d. for gas. An engineer is to report on the question.

Montrose and Electric Lighting.—A deputation in connection with the electric lighting have visited Edinburgh, Coatbridge and Glasgow, and will submit their report shortly. Generally speaking, the result of their enquiries has been highly satisfactory, and the Provost considers would warrant them to go in for electric lighting at no distant date.

An Experiment in Long Distance Telephony.—An interesting experiment in long distance telephony was made a short time since on one of the Chicago-New York telephone circuits. On March 21st a meeting of the American Institute of Electrical Engineers was held in New York, and simultaneously a meeting of the Chicago members of the Institute was held in Chicago. The circuit was held throughout the evening in direct communication between the two meetings. An address was made to both meetings by Prof. Houston, President of the Institute, who, speaking in New York, was heard by nearly 50 members of the Institute in Chicago, 1,000 miles away. Subsequently various points in Prof. Anthony's paper on glow lamps were discussed over the circuit, and the experience of those participating in the experiment is said to have been most enjoyable and satisfactory.

Electric Illumination.—Prof. Fleming continued his series of lectures on "Electric Illumination" at the Royal Institution on Tuesday afternoon. He described the various systems of photometry; then passed on to consider the construction of incandescent lamps. The expansion of a carbon rod when a current passed was projected on to the screen. With a singular aptness of phrase, Prof. Fleming said that the use of the exhausted bulb was to "vacuum jacket the filament," in order to prevent energy passing from the filament to the glass in a form not useful to the eye. Speaking of large incandescent lamps, he said the difficulty in the way of these was the enormous air pressure which existed on the outside of a lamp. One of 2,000 C.P. which he showed to the audience had a surface of 300 square inches, and with the pressure of the atmosphere, there would be a total of about $1\frac{3}{4}$ tons on each lamp. That, of course, had to be taken into account when manufacturing them, and the bulbs had to be made sufficiently strong to withstand the pressure. The various ways of arranging lamps were next described. The lecturer gave some valuable advice concerning the use of incandescent lamps. To obtain the best effect from an incandescent lamp, the filament of the lamp ought never to be seen. One could get better effects by covering it with an opaque screen, although it cut off 40 or 50 per cent. of light.

Electric Light at Chicago.—An American contemporary says that very few persons have any idea of the extent to which electric lighting has been applied in Chicago. The inspection department of the city government announces that there are 22 central stations and 500 isolated plants in the city, operating 15,000 arc lights and 300,000 incandescent lamps. These figures are official and may be relied upon. The chief of the inspection department calls attention to the fact that much of the construction work, especially that which was done several years ago, is in a wretched condition and should be overhauled at once, but owing to the small number of inspectors furnished by the city it is impossible to do much more than keep up with the new work. Chief Inspector Norton says: "It has been satisfactorily proven in our experience that a periodical inspection is imperative, and we must face the fact that our work must be gone over completely at least every two years. Many special risks require even more attention and should receive re-inspection every six months." Of course, if sucha condition could be brought about, the standard of construction would show material advancement, and the effect upon the electrical interests would be beneficial. It is urged that the receipts of the department should be expended in improving and enlarging the service. Mr. Norton argues that the advantages to the city from the improvements in the service would repay it for this outlay.

Appointment.—Mr. Edgar Maple has been appointed resident working electrical engineer to the Blackpool Corporation.

Belfast Vacancy.—For the post of resident electrical engineer there were nearly 60 applications. From these 10 have been selected, from whom the Council will appoint their engineer.

The Electric Lighting at Ealing.—The surveyor has informed the board that the work in connection with the lighting of the district by electricity is progressing. Applications for private lighting had already been received, and it was anticipated that when the system came into operation, a considerable amount of private electrical lighting would be used in the district.

Fatal Accident at Cannes.—Says *Le Littoral* of March 31st: A few days ago at Cannes, during a storm, an electric wire used for the lighting of a villa suddenly snapped, breaking off near a support placed in the garden of the villa, and hanging down close to the ground. Madame Morel, the occupier of the villa, who was in the garden at the time, was about to push it away with her foot, when she was warned by her coachman not to touch it. Somewhat alarmed, she went into the house. On coming out again a few moments after, she was horrified to see the coachman lying motionless on the ground, holding the wire in his hand. Every effort was made to restore him to life, but without avail, as death had no doubt been instantaneous. The electric current, although dangerous in the wires which convey it across the outskirts of Cannes, is perfectly harmless in those that are close to the houses and villas, it being transformed before it enters them.

Lectures.—Mr. T. Scott Anderson is giving a course of lectures on "Electrical Engineering" in the Central High School, Sheffield.

At a meeting of the Cleveland Institution of Engineers, Middlesbrough, Mr. D. Selby Bigge, of Newcastle, last Monday read a paper on "Electric Power Installation."

Mr. R. S. Williamson, of the Cannock and Rugeley Colliery, read a paper upon "The Jeffery Electric Coalgetter" at the meeting of the South Staffordshire and East Worcestershire Institute of Mining Engineers, held at Mason College, Birmingham, last week.

At a meeting of the Liverpool Engineering Society, last week, a paper on "Some Methods of Regulating Pressure in Electric Light Circuits" was read by Mr. Wilfrid S. Boult, Assoc.M.Inst.C.E.

Before the Sheffield Society of Architects and Surveyors, on Tuesday, was read a paper on the "Production and Distribution of Electric Light for Domestic Purposes," by Mr. Wm. Johnson, the manager and secretary of the Sheffield Electric Light and Power Company, Limited.

CITY NOTES.

Electric Lighting in the City.

The City of London Electric Lighting Company have issued notices of the streets in which they can now supply current. The list comprises 406 streets, courts, lanes, and apparently most of the principal thoroughfares being included. There has been a great deal of grumbling in the western portion of the City about the delay in laying mains, but we really believe the difficulties which the company has had to encounter have been enormous. Unfortunately many probable consumers were prevailed upon to have their premises wired months ago in the expectation of being speedily connected to the mains, but they have been grievously disappointed; in fact, we know of a case of a shopkeeper becoming so disgusted, that he had the fittings torn down and replaced by Welsbach gas burners. We do not think that the company is altogether responsible for this; they do not seem to have unnecessarily delayed the work; in fact, we cannot conceive of them doing anything but pushing on as rapidly as possible.

Foreign Markets.

With reference to our article on "Promising Foreign Markets," published in our last issue, we have received a letter from the Editor of *El Ingeniero Español y La Gaceta Sud Americana*, which ought to be of supreme interest to many of our readers:—

"The Editor, Electrical Review.

"London, April 11th, 1894.

"Sir,—Your article on 'Promising Foreign Markets' should be appreciated by the manufacturers reading your paper; and it comes just at the right juncture. The troubles in Brazil are rapidly disappearing, and a stable Administration may now confidently be looked for, when one of the best markets will accordingly be opened. But (and I speak with some knowledge) I would urge manufacturers not to send representatives out there to do business direct with the consumer, but to transact their trade through the resident 'middleman;' for should they do the former, a practical 'boycott' will be at once established against them. Agricultural implement manufacturers can doubtless tell a sorry tale on this score. The accepted method is for the indent to come through an accredited London (or British) mercantile house, who then are directly responsible to the manufacturer, and pay the latter on production of bill of lading. I need hardly say that your remarks as to 'Brazilian methods of doing business' are thoroughly deserved; in fact, I could supplement them with much more pointed expressions, were it necessary to do so.

"Yours faithfully,

"The Editor,

"*El Ingeniero Español.*"

The Indo-European Telegraph Company, Limited.

The directors' report for 1893, to be presented at the meeting on 26th inst., states that the company's revenue from all sources for 1893 amounted to £122,860 10s. 4d., as compared with £117,479 13s. 10d. for 1892, showing an increase of £5,380 16s. 6d. The expenses were: on commercial and general account £34,916 5s. 11d.; on maintenance account £30,043 11s. 7d.; total £64,959 17s. 6d., as against £62,148 16s. 3d. for 1892, an increase of £2,811 1s. 3d. Deducting the above expenses, taking credit for £7,557 16s. 11d. brought over from 1892, and debiting income tax, there remains the sum of £63,952 3s. 8d. From this amount £15,000 has been placed to reserve, and that sum, together with £10,625, amount of interim dividend, have to be deducted, leaving a balance of £38,327 3s. 8d. The directors now propose the declaration of a dividend for the six months ending December 31st, of 17s. 6d. per share, making, with the dividend already paid, 6 per cent., and a bonus of 20s. per share, both free of income tax, making in all 10 per cent. for the year, carrying forward £6,452 3s. 8d. to the credit of 1894. The directors have to express their deep regret at the loss of the valuable services of their late colleague, Mr. Weaver, who died last September, and who had been connected with the company since its incorporation. The following directors retire by rotation, and offer themselves for re-election:—John von Berenberg Gossler, Esq., and H. H. Meier, Esq. The auditors, Messrs. C. F. Kemp, Ford & Co., public accountants, retire, and offer themselves for re-election.

Great Northern Telegraph Company of Copenhagen.

A statement has as usual been published by the directors regarding the working of the company's system during the year 1893. The traffic receipts, together with the balance from December 31st, 1892, and other sundries, less loss on exchange, has amounted to £352,974 17s. 4d., against £357,556 11s. 4d. last year. Under the head of expenditure, salaries and wages are given at £42,515 17s., against £41,375; expenses of stations, offices, and agencies, £6,847 17s. 8d., against £7,615 18s. 11d.; ordinary supervision and maintenance of the sea and land lines and repairing steamers, *H. C. Orsted* and *Store Nordiske*, £18,559 19s. 11d., against £15,442 2s. 10d.; instruments and cells, £1,736 4s. 7d., against £3,015 17s. 7d.; maintenance of buildings, £714 9s, against £595 5s. 2d.; rates and taxes, £5,132 0s. 8d., against £3,265 18s. 5d.; travelling expenses, £369 4s. 5d., against £373 13s. 11d.; bank commission, &c., £1,549 3s. 7d., against £2,294 13s. 7d.; sundries, £367 18s. 5d., against £383 5s. 10d.; 5 per cent. interest on debentures, 1883 issue, and amortisation of 100 debentures, £20,250. The board propose distributing the balance in the same way as last year, carrying forward only £38,154 6s. 6d., instead of £45,666 18s. 9d., *i.e.*, interim dividends already paid, £75,000: final dividend proposed (Kr. 6.50 equal 7s. 2d. per £10 share), £54,166 13s. 4d.; reserve and renewal fund, £83,333 6s. 8d.; pension fund of the staff, £2,777 15s. 7d.; remuneration to the board of directors, £1,500.

Eastern Extension Telegraph Company.

The report of the Eastern Extension, Australasia and China Telegraph Company for the half-year ended December 31st, states that the gross receipts, including Government subsidies, amounted to £251,698, against £247,767 for the corresponding period of 1892. The working and other expenses, including £21,122 for cost of repairs to cables and expenses of ships, absorbed £76,575, against £91,769, leaving a balance of £175,123. From this is deducted £4,015 for income tax, and £31,895 for interest on debentures, debenture stock, and contribution to sinking fund, leaving as the net profit £139,213, which, with £81,117 brought forward from the previous six months, shows an available balance of £220,330. One quarterly interim dividend of 1¼ per cent. has been paid for the half year, and it is now proposed to distribute another of like amount, making, with the interim dividends paid for the first six months, a total dividend of 5 per cent. It is also proposed to pay a bonus of 4s. per share, or 2 per cent., making a total distribution of 7 per cent. for the year. The balance of £107,830 has been carried to the general reserve fund, which, after being credited with interest received on investments, now stands at £633,686.

Bournemouth and District Electric Supply Company, Limited.

The third annual general meeting of this company was held on the 30th ult., when the report of the directors and statement of accounts for the year ended December 31st, 1893, were submitted and adopted.

The acting-chairman (Mr. Leveson Scarth) in the course of his remarks, stated that the business was progressing with reasonable rapidity, and had now reached the stage of being a dividend-earning concern, the directors having decided to recommend the payment out of profits of two-thirds of a 5 per cent. dividend on ordinary shares, the Brush Company paying the remaining one-third under their guarantee, which does not expire till June next. The directors had devoted much attention to mains and cables, and were incurring considerable expense in accelerating the policy of laying down concentric cables throughout the system. All the requirements of the Board of Trade were being promptly satisfied, and the directors wish to acknowledge the courtesy with which these works were being facilitated by the Town Council and surveyor. The plant at the central station had been, and was still adequate to the load as stated in the report, but the directors anticipated an increase of at least 30 per cent. in the output during the ensuing year, and this would necessitate additional engines and alternators; at the same time, they would endeavour to preserve the greatest economy in running expenses. During the last two months Mr. A. J. Lawson, M.I.E.E., had been acting as consulting engineer, and the directors, out of a large number of applications, appointed as resident engineer Mr. H. M. Sayers, at present engineer to the electric lighting company in Oporto. Mr. Sayers would take technical charge of the company's system as from April 20th. Mr. Shepherd's connection with the company, for which he had done much work since its formation, had now terminated. In moving the adoption of the report and accounts, the acting chairman stated that the directors looked forward with confidence to declaring a fair dividend out of the earnings of the company during the current year.

The retiring directors, Mr. John Fair and Mr. William Fisher, were re-elected.

Southampton Electric Light and Power Company.

The annual meeting of this company was held last week, Mr. G. T. Harper, J.P., presiding.

From the report presented by the Secretary, it appeared that the increased revenue amounted to £553 9s. 10d., whilst the expenses were practically the same as in 1892, and the net profit was £170 1s. 11d. This reduced the total loss to £184 17s. 10d. A dividend at the next annual meeting was foreshadowed.

On the motion of the Chairman, seconded by Mr. F. Turner, the report was adopted, and the retiring directors and auditor were re-appointed.

Anglo-American Telegraph Company, Limited.—The board have resolved to declare an interim dividend for the quarter ending March 31st, 1894, of 9s. per cent. on the ordinary stock and 18s. per cent. on the preferred stock, less income tax, payable on May 1st to the stockholders registered on the books of the company on March 31st, 1894.

Great Northern Telegraph Company.—The directors of this company have declared a dividend of 8 3 per cent. for 1893. The report for the year states that the net income amounted to 4,953,278 kronen.

West Indies and Panama Telegraph Company.—The directors of this company recommend a dividend of 6s. per share on the first and second preference, and 9d. per share on the ordinary shares, for the half-year ended December 31st.

County of London and Brush Provincial Electric Lighting Company, Limited.—The letters of allotment in this company's first issue of 19,900 ordinary shares are being posted.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending April 8th, 1894, amounted to £852; week ending April 9th, 1893, £842; increase, £10; total receipts for half-year, 1894, £12,886; corresponding period, 1893, £12,856; increase, £30.

The Western and Brasilian Telegraph Company, Limited. The receipts for the week ending April 6th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brasilian Telegraph Company, Limited, were £3,113.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation, April 4th.	Closing Quotation, April 11th.	Business done during week ended April 11th, 1894. Highest.	Lowest.
184,500£	African Direct Teleg., Ltd., 4 % Deb.	100	...	...	...	100 —103	100 —103	...	...
1,134,640£	Anglo-American Teleg., Ltd.	Stock	£2 12s.	£2 15s.	£2 11s.	42 — 44	41 — 43	42½	41½
2,932,680£	Do. do. 6 % Pref.	Stock	£5 5s	£5 10s.	£5 2s.	79 — 80	79 — 80	79½	78
2,932,680£	Do. do. Defd.	Stock	...	...	...	7¼— 7⅜	7¼— 7⅜	7⅜	7⅛
130,000	Brazilian Submarine Teleg., Ltd.	10	8 % §	6½% §	6½% §	11⅜— 12¼	11⅜— 12¼	12⅛	11¹⁵⁄₁₆
18,700£	Do. do. 5 % Bonds	100	...	...	...	99 —102	100 —103	...	...
75,000£	Do. do. 5 %, repayable June 1906	100	...	...	...	107 —111	107 —111	108½	...
44,000	Chili Telep., Ltd., Nos. 1 to 40,000	5	... §	10%‖ §	... §	1½— 2½	1½— 2½	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	146 —150	146 —150	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	3½% §	2 % §	... §	1/16 — 3/16	1/16 — 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12 — 13	12 — 13	12¼	12
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18 — 19	18 — 19	...	...
12,931	Direct Spanish Teleg., Ltd., £4 paid	5	4½%	4 %	4 %	2½ 3 xd	2½— 3	...	...
6,000	Do. do. 10 % Pref.	5	10 %	10 %	...	8½— 9 xd	8½— 9	...	...
60,710	Direct United States Cable, Ltd., 1877	20	3½% §	3½% §	...	9¾— 10¼	9 — 9½	10	9 1/16
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½% §	...	15 — 15¼	15 — 15¼	15 3/16	15
70,000	Do. 6 % Pref.	10	6 % §	6 % §	...	16 — 16½	16 — 16½	16 1/16	16 1/16
105,900£	Do. 5 % Debs., repay. August, 1899	100	...	...	...	107 —110	107 —110	108½	...
1,294,100£	Do. 4 % Mort. Deb.	Stock	...	...	...	114 —117	114 —117	117	114½
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	15½— 15¾	15½— 15¾	15¾	15¼
62,700£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	...	...	...	103 —106	103 —106	...	...
222,800£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	...	...	...	103 —106	103 —106	104	...
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	113 —116	113 —116	116	113½
95,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	...	...	...	103 —106	103 —106	105	...
129,100£	Do. do. do. to bearer, 2,344 to 5,500	...	...	...	...	103 —106	103 —106	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 2,016, red. 1909	100	...	...	...	104 —107	104 —107	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	...	...	...	107 —110%	107 —110%	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	5¼% §	4⅞% §	4⅝% §	8⅞— 9	8⅞— 9	8 15/16	8⅞
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	6 % §	15½— 15⅝	15½— 15⅝	15 15/16	15½
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅗% §	8⅗% §	8 3/16 %	21¾— 22¼	21¾— 22¼	...	...
200,000£	Do. do. do. 5 % Debs.	100	...	...	...	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	...	43 — 45	45 — 47	46	...
37,548	London Platino-Brazilian Teleg., Ltd.	10	...	...	...	4 — 6	4 — 6	...	...
100,000£	Do. do. 6 % Debs.	100	...	...	...	106 —109	106 —109	...	...
15,000	Monte Video Teleph. Co., Ord., 1 to 15,000	5	...	...	...	½— 1½	½— 1½	...	...
28,000	Do. do. 6 % Pref., 1 to 28,000	5	...	...	...	1 — 2	1 — 2	...	...
484,597	National Teleph., Ltd., 1 to 438,984	5	6 % §	5 % §	...	4⅜— 4⅞	4⅜— 4⅞	4 13/16	4 11/16
15,000	Do. 6 % Cum. 1st Pref.	10	...	...	...	14½— 15½	14½— 15½	15⅛	...
15,000	Do. 6 % Cum. 2nd Pref.	10	...	...	...	14 — 15	14 — 15	14¾	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 90,950	5	...	...	...	5⅜— 5⅝	5⅜— 5⅝	5 11/16	5 5/16
925,017£	Do. 4½ % Deb. Stock Prov. Certs. ...	...	...	...	...	115 —117	115 —117	116⅛	116
48,800	New Teleph., Ltd., 25,901 to 74,700; £4 paid	10	...	...	...	... ...	... ...	...	...
220,000	Oriental Teleph., Ltd., 80,001 to 300,000; 11s. paid ...	1	2¼%	3⅜%	4½%	... ...	... ...	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	...	...	...	102 —105	102 —105	...	...
11,839	Reuter's Ltd.	8	5 %	5 %	...	5½— 6½	5½— 6½	...	...
3,381	Submarine Cables Trust	Cert	...	...	...	113 —118	113 —118	...	...
58,000	United River Plate Teleph., Ltd.	5	...	...	...	1½— 2	1½— 2	1 13/16	1½
146,370£	Do. do. 5 % Debs.	Stock	...	...	...	90 —100	90 —100	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	4 %	..	...	3 — 5	3 — 5	...	...
249,900£	Do. do. do. 5 % Debs.	100	...	...	...	99 —102	100 —103	101½	...
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	2½— 3	2½— 3	2⅝	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	...	...	...	101 —105	102 —106	103	...
64,242	Western and Brazilian Teleg., Ltd.	15	4 %	2½%	...	7½— 8	7½— 8	7⅞	...
33,129	Do. do. do. 5 % Cum. Pref.	7½	...	...	...	6 — 6¼	6 — 6½	...	...
33,129	Do. do. do. 5 % Def.	7½	3 %	...	...	2 — 2¼	2 — 2½	...	...
178,200£	Do. do. do. 6 % Debs. "A," 1910 ...	100	...	...	...	105 —108	105 —108	107	...
222,700£	Do. 6 % Mort. Debs., series "B," red. Feb. 1910	100	...	...	...	105 —108	105 —108	107	...
88,321	West India and Panama Teleg., Ltd.	10	¼%	¼%	...	1¼— 1½	1¼— 1½	...	...
34,563	Do. do. do. 6 % 1st Pref. ...	10	...	...	...	10¼— 10⅝	10¼— 10⅝	10⅝	10¼
4,669	Do. do. do. 6 % 2nd Pref. ...	10	...	...	..	9 — 10	9 — 10	9¼	...
80,000£	Do. do. 5 % Debs. (1917) No. 1 to 1,000	100	...	...	...	107 —110	107 —110	...	...
$1,214,000	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	...	...	...	113 —118	113 —118	...	...
169,000£	Do. do. 6 % Ster. Bonds.	100	...	...	...	100 —104	100 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

20,510	Charing Cross and Strand Electy. Supply, 1 to 6, 215 to 718, and 10,001 to 30,000	5	...	5 %	4½%	4 — 5	4 — 5	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,000—180,000	10	...	...	...	11½— 12½	11½— 12⅛	12⅜	12⅛
20,000	Do. do. 6 % Cum. Pref., 1 to 20,000	10	...	6 %	6 %	13¼— 13¾	13¼— 13¾	13⅜	13¼
19,900	*Electy. Supply Co. of Spain, 101 to 20,000...	5	...	...	...	... ...	... ...	...	...
5,523	†Liverpool Electric Supply, £4 10s. paid	5	...	...	...	5½— 5⅝	5⅞— 6⅛	5⅝	5⅜
39,477	Do. do.	5	4½%	5 %	5 %	6⅛— 6⅜	6 7/16— 6 1/16	6⅜	6¼
49,900	*Metropolitan Electric Supply, Ltd., 6,101 to 50,000 ...	10	1 %	2 %	...	8 — 8½	7½— 8	8 5/16	8 3/16
100,000£	Do. 5% Deb., 1 to 10,000 in bonds of £10, £20, £40	...	...	...	...	106 — 109	106 —109	109	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	...	4½— 5½	4½— 5½	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-18,780	5	8½%	7¼%	4½%	6¼— 6⅝	6¼— 6⅝	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 8½	8 — 8½	8⅛	8 1/16
59,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	...	3½%	4 %	5⅞— 6¼	5⅞— 6¼	6	5 13/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ¶ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation, April 4th.	Closing Quotation, April 11th.	Business done during week ended April 11th, 1894. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000	3	...	6 % §	6 % §	3 — 3¼	3 — 3¼	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	...	6 % §	6 % §	2⅛— 2⅜	2⅛— 2⅜	2¼	...
125,000/	Do. do. 4½ % Deb.	Stock	...	...	...	108 —111	108 —111	...	...
630,000/	City and South London Railway	Stock	...	⅝%	⅝%	27 — 32	27 — 32	...	...
20,000	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 20,000	5	7 % §	7 % §	7 % §	3½— 4	3½— 4	...	...
50,000/	Do. do. 5 % 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	...	...	...	95 —100 xd	95 —100	...	...
120,000	Electric Construction, Ltd., 1 to 120,000	2	...	...	...	½— ¾	½— 1	1/16	½
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	...	...	...	1¼— 1⅝	1½— 2	1 1/16	1½
100,000	Elmore's French Patent Cop. Deposg., Ltd, 1 to 66,750 ...	2	*nil*	*nil*	*nil*	¼— ⅜	¼— ⅜	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil* ¶	*nil*	*nil*	½— ¾	½— ¾	...	...
67,385	Elmore's Wire Mfg., Ltd., 1 to 67,385, issued at 1 pm. ...	2	*nil*	*nil*	*nil*	½— ¾	½— ¾	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	*nil* §	½— 1½	½— 1½	...	...
12,134/	Greenwood & Batley, Ltd., Ord., 4,667 to 16,800	10	...	...	...	4½— 5½	4½— 5½	...	...
9,600/	Do. do 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	...	...	6½— 7½	6½— 7½	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	12½%	23 — 24	23 — 24	23⅝	23¼
200,000	Do. do. do. 4½ % Deb., 1896	100	...	...	...	101 —103 xd	101 —103	...	...
11,334	International Okonite, Ltd., Ord., 22,667 to 34,000 ...	10	5 % §	...	...	1 — 2	1 — 2	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	...	1 %	5¼— 5½xd	7⅛— 7¾	7 1/16	5
6,295 †	Do. do. Pref., £8 paid	10	...	...	...	9 — 9½xd	11⅜— 12½	...	...
78,949	Swan United Electric Light, Ltd., £3½ paid	5	11 % §	10 % §	7½%§	2 — 2½	2 — 2½	...	...
37,250	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	20 %	39 — 41	39 — 41	39⅞	39
150,000/	Do. do. do. 5 % Bonds, red. 1894	100	...	...	...	... ...	... ...	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%§; 1891—7%§; 1890—8%§.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5⅜—5⅞.
Brush Company, 4½ % Debenture Stock, issued at 1 % premium, 106—108.
Electric Construction Corporation, 6 % Debentures, 87—92.
Electric and General Investment, shares of £5 (£1 paid), 1¾—2¼.
Electricity Supply Corporation, Ordinary of £5, 5—5¼.
House-to-House Company (£5 paid), 1—1½.
Do. do. 7 % Preference, of £5, 5¼—5½.
Do. do. 6 % Debentures of £100, 101—103.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 4⅜—5¼; 1st Preference Cumulative 6 %, £5 (fully paid), 6¼—6⅞.
Liverpool Electric Supply, £5 (fully paid), 6½—6¾.
Do. do. £3 10s. paid, 4½—4¾.
London Electric Supply Corporation, £5 Ordinary, ¾—1¼.
Queen Anne's Mansions Lighting and Heating Company, 6 % £100 Debentures, 101—103.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares (£4 10s. paid), 4¼—4⅜.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

COUNTRY HOUSE ELECTRIC LIGHTING.

By S. À COURT.*

Large country houses, when in an isolated position, and out of reach of a gas company's supply main, are now usually lighted by means of electricity. By a country house the author means any large private house containing some 30 or more rooms, and requiring 100 or more points of lights.

Of such houses there are a great number in the United Kingdom, chiefly owned by comparatively well-off persons, who can afford to pay much more for the burning of a cleanly and steady source of light than they would for lighting by means of oil lamps.

The lighting of small country houses is at present chiefly carried out by means of paraffin oil lamps, which necessitate a lamp room, and the cleaning, filling and trimming of the lamps regularly every day, and this is at once the cheapest and most convenient method of lighting where the total number of points required is below 100, but when above this number the work of cleaning and attending to the lamps becomes heavy, and in establishments where water has to be pumped for domestic use, or where the proximity of the "home farm" will conveniently allow it, the motive power for a dynamo during the evening is very conveniently combined with pumping water, cutting chaff, pulping roots or sawing timber during the day.

There are certain points to be considered in each individual case before deciding what method of producing power is best and most economical, such as cost of coal, coke, or paraffin oil delivered on the spot, if water power is available and how far off, besides the position of the house itself, and also for how many months in the year it is usually occupied.

Wind power for water pumping purposes has of late come into use, chiefly owing to the great improvements in windmills, which are now of neat construction and combine low first cost with slight expense for attention, while, as a source of power, the economy of its use is no less than 1½ times that of a steam pump, besides obviating the first cost of a boiler, and also doing away with the necessity for skilled attendance.

The extra expense required is the storage, which should not be less than at least three days' average daily consumption, to allow for possible calm days, or when the wind velocity is less than six miles an hour.

The author, by the kindness of Mr. Alwyn, of the Brush Company, has been able to lay before you a copy of the *Scientific American* newspaper, in which is a very full description of the plant and apparatus erected and used by Mr. H. C. Brush at his private house in Cleveland, U.S.A., where a 60-foot windmill is used for driving a dynamo, the current from which is stored in no less than twelve batteries of 34 cells each, each cell of 100 ampère-hours' capacity, giving a total of 40,800 ampère-hours stored.

The entire plant and apparatus is automatic, and the only attention required is that of oiling the journals and bearings at the mill, and inspecting of the batteries.

The number of lights in daily use amount to 100, averaging 8-candle-power, which, at 4 watts per candle and a maximum of 6 hours per lamp in winter, and allowing for the arc lamps to be used 6 hours and the motors 4 hours a day, the latter of 1 H.P. each, gives a total of 1,000 ampère hours required: thus the storage is sufficient for a full month, while one-tenth would have been ample.

No figures are available of the first cost or annual expense, but the latter must be considerable, taking interest and depreciation at 12 per cent. only.

This last source of power seems to have been as yet very rarely employed for driving dynamos. The author has made enquiries of several manufacturers of windmills, as also of electrical contractors, and can only discover *one* installation in England in which wind power has been used for electric light.

In this solitary case the windmill was used to charge storage batteries, the mill being usually run during the day, driving a shunt wound dynamo.

This most interesting installation, which was at Messrs. Carwardine's Flour Mill in the City Road, in so far as wind power is concerned, is now disused, and gas has taken the place of the wind, and a gas engine now charges the storage cells, and also works the mill.

The "Halladay" sectional wheel, erected by Messrs. Alfred Williams & Co., was 30 feet in diameter, and classed at 8 H.P. and drove an Elwell-Parker dynamo, charging 28 E.P.S. accumulators with 30 ampères at a pressure of 81 volts, besides the mill machinery. The regulating apparatus was self regulating, and automatically cut in the dynamo when the speed was high enough, and inserted resistances into the shunt when the E.M.F. became too high.

The mistake in this installation was the small amount of storage capacity provided; the full requirements of the building consisted of 27 16-candle incandescent and 3 12-ampère arc lamps. As mentioned lower down in this paper the storage should be equal to at least *four* days' consumption.

Water.—Water power, if the supply is pretty constant, and not liable to dwindle to zero in summer, with a corresponding maximum of flood in winter, is the most convenient and economical source of power, though seldom available in this country: a notable example of its application is at the new installation at Chatsworth.

* Read before the Civil and Mechanical Engineers Society.

Steam.—Steam power is more employed than any other, because cheap water power is comparatively rare; in nearly every available stream the milling rights are of considerable value, and the power is chiefly taken up by flour mills or other long established businesses.

Steam power plant is comparatively cheap to buy, and can be made portable at a slight increased cost. There is no necessity to discuss its application in detail, as it is so universal.

Gas.—Gas power, by which is meant gas being generated, stored, and used on the premises, and not supplied by a public company, has made considerable strides in the last few years, chiefly owing to Mr. R. Dowson's inventions and improvements.

Where private gas works already exist, as they do at some country houses, if the gasholder is in good condition, the plant can be adopted for producing non-illuminating gas at comparatively low cost, which can be used for heating and cooking purposes in the house, as well as supplying motive power to a gas engine to drive a dynamo.

The chief point in favour of Dowson gas is the very low cost to produce. The amount of coal required in ordinary working comes to about 1½ lbs. of anthracite per I.H.P. hour, using gas engines of 16 H.P. nominal, and working at full load, which compares favourably with the best form of steam engine. The standby losses are very slight, as the generator can be stopped, when required, in a few minutes, and with the storage of the gasometer, the engine may be re-started first, and the generator later. The attendance and repairs are practically equivalent to what is required by a steam plant of equal size.

The first cost of laying down a Dowson gas plant varies from £12 to £3 per I.H.P. for power from 15 to 100 I.H.P., to which must be added the cost of the gas engine, but, of course, no boiler is required.

Oil.—Oil engines, in which the oil is admitted drop by drop into a "vapouriser," and then mixed with air and exploded, have lately come considerably to the front, being much simplified and improved in construction and economy of running. In a report by Mr. Worby Beaumont on some trials with a 6 H.P. actual engine in May, 1893, the cost with oil at 4d. per gallon came out as ·348d. per I.H.P. at full load.

As a fuel, oil at the present time seems likely to become extensively used, for the recent complete disorganisation of our coal supplies has opened peoples' eyes to the necessity for something to supplement coal for production of steam, as well as for direct production of power in an oil engine, but we should not lose sight of the fact that in case of a war with any foreign power, our supplies of oil might cease entirely, should we lose our command of the sea.

A low grade of oil or petroleum refuse is largely used in parts of Russia both for stationary, locomotive, and marine boilers, and in England, on the Great Eastern Railway, Mr. Holden has, for some years, been working at its application to locomotives in particular, (using tar) with very good results.

The matter is so important that lately, in several instances, the author has found that arrangements have been made so that should the coal supply fail, oil can be used instead without necessitating any alterations to the boilers beyond the fixing of the steam jets and oil feeding apparatus, which can be done in a very short space of time.

A bed of ashes is necessary to preserve the fire-bars from injury, due to the increased heat, but a very small supply of coal will evidently suffice for this, and for starting the heat.

Motors.—In nearly all country houses where electric power is in use, motors of small powers can be conveniently used, and a move in this direction is slowly being made.

Electric lifts can be used for hauling coals or visitors' luggage to the top of the house, or even for the speedy delivery of the dinner from the kitchen.

Boot brushing machines, knife cleaners, churns, are easily worked by a small ¼-H.P. motor, not to mention the convenience of larger sizes for raising water or pumping sewage.

In the house, again, electricity is beginning to be used for cooking and heating, and in the latter respect, in particular, is of great use as affording a ready and convenient method of warming, and thereby airing rooms.

Stoves.—Messrs. Crompton & Co. have lately made this a special line, and are now making cooking stoves of a size capable of preparing food for a household; they are built like gas stoves, but work with the natural advantage of absence of smell of gas and necessity for ventilation.

Storage of Power.—For country house electric lighting purposes it is evident that some form of storage of power is necessary, because of the intermittent use of current. After 10.30 p.m. most of the lights are turned off, but a few are always required up to midnight or later.

Power may be stored in various ways: In an electric storage battery, pumping water up to a reservoir on a neighbouring hill, and super-heating water in storage cylinders, are examples; but the first is the one most generally employed because it affords not only storage, but also a convenient means of regulating the current for supply of light, and the other systems are hardly applicable to installations of less size than 5,000 lamps, even if the conditions are favourable, owing to the heavy initial outlay.

For special cases water storage might be adopted, but few persons would care to go to the expense.

Dynamos.—The author is of opinion that the great hold that the direct current system, as opposed to the alternating, has in England, is, to a great extent, due to to the number of private house installations carried out before central stations for town lighting and supply were even designed. The experience gained in private work by manufacturers was necessarily all in direct current dynamos.

Shunt-wound direct-current dynamos are chiefly used as giving the necessary higher volts with less current towards the end of the charging, while an automatic magnetic cut-out should be invariably added, as it prevents a chance reverse current from the storage batteries through the dynamo, and also acts instead of a switch when it is desired to cease running.

Batteries.—Of the various types of storage batteries it is not necessary to speak in this paper. It may be noted, however, that the intelligent employment of a recording meter will help enormously in keeping a check on the efficiency of a plant, and in particular on the state of the storage battery. Mr. Gisbert Kapp drew attention to this point in a paper read by him in April 1893.

Maintenance of Cells.—The manufacturers of storage cells advertise to undertake to keep them in proper condition, renewing bad plates, filling up with acid or water, &c., for a percentage on the first cost of the battery; however, when it comes to the point of a contract for this, the price will generally be found about 10 per cent. (if the battery is first of all supplied and put up by them, this sum should not exceed 8 per cent. per annum), unless the battery is large compared with the work it has to do.

The Man in Charge.—This brings us to the important consideration of the man in charge of an installation, who is sometimes capable, but often not.

Many employers seem to think that an understanding and careful man can be got for 30s. a week, and then expect to have a man whose training and experience is such that he may be left in (generally) entire charge of an installation costing perhaps £2,000, of which the battery alone has cost £500.

Nothing requires more constant and intelligent supervision than a storage battery, and a competent man can save his employer more than his salary every year.

How often do we not hear the complaint of the whole cells being useless, all gone wrong, plates buckled and short-circuited, separators not doing their duty.

One bad "run-down" of a battery may mean its destruction. Even the excessive over-discharge of one cell will spoil that one unless it is disconnected and doctored up again.

Mr. Ashworth, in a recent number of *Cassier's Magazine*, also draws attention to a second and more universal source of trouble, viz, the want of training in firing the boiler. A man in charge of an installation comprising a steam engine, boiler, and storage cells should not only be a capable electrician, but also have had proper training as a stoker and engine driver.

A capable man can, again, here more than save his employer fully 10 per cent. by careful firing, and it is more than worth while for an employer to *pay* (as is done by most railway companies) for increased economy in the use of coal.

The larger the installation, and the higher the "load factor," the more important does coal become, and here is where the use of a recording meter, as mentioned already, proves its usefulness.

The moral is that contractors and consulting engineers should be more careful to recommend only good men—and use their influence in their clients' interests to see that they are paid a fair wage.

Design of an Installation.—An important point which should always be carefully studied when designing a country house installation, is the amount of current usually required, as well as what the maximum demand will be, for the local conditions should be carefully considered as no two houses are alike in these particulars.

In the case of a large installation, which becomes almost a so-called central station, it may even be more economical to run direct during the time of heavy load, and use a small battery for the day load, and for after 12 p.m., while in a smaller installation it may be found better to lay down a smaller generative plant, and rely chiefly on the battery, charging up during the hours of the day, and thereby running at the maximum efficiency of the power plant. It is always best to have too large rather than too small a battery, for then in case of accident to the power plant we have spare storage to take its place, at all events, for the necessary lights.

One of the most difficult problems that a consulting engineer is called upon to solve, and which requires most careful consideration, is the re-designing or arranging small installations originally carried out by contractors, whose one aim seems to have been to lay down as much plant and apparatus as possible, without any consideration of the local requirements.

The author does not wish to suggest that this practice is universal, and no doubt much work, when originally carried out, was at the time considered to have been carefully planned, but of late special attention has been given to cost of running, and from experience gained by the pioneer installations, even a contractor without a consulting engineer's knowledge to help him should be able to design the proportions of generative plant and storage to the best advantage.

Annual Cost.—In comparing the annual expense of various small installations, stress is often laid on the cost per unit generated or supplied to the lamps, as if a house of some 200 lights could be compared with a central station with 20,000 lamps connected to its mains.

To refer again to a recent paper by Mr. Gisbert Kapp, it will be seen that the cost per unit generated, including repairs and 8 per cent for interest and depreciation for five private houses of from 70 to 720 lamps, will average rather over 14d. (14·079); when, however, we analyse the results from installations of from 1,000 lamps and upwards, where the current is in use daily, and for commercial purposes, we find that the cost falls at once to 3d. or even under.

It may be taken as proved that no installation for a private house where any power is used, except water power, can be expected to supply current at anything like the low price that a supply company charges.

Some owners of country house installations look very closely to the total cost per annum, having usually had an estimate of its probable cost from the contractor who put it in, but even if this sum comes out near the figure originally estimated, yet at intervals the item of renewals comes out very high, particularly when storage cells are used; while on the other hand some owners do not seem to mind what the electric lighting costs provided the light is steady and ample, and they are not bothered by complaints from their engineer or electrician in charge.

The author has obtained some figures of annual cost from three

typical installations, when the power is in one case water, and in the other two steam, which are as follows:—

Case I.—Water Power.

Here the whole of the work required for damming the river and regulating the level of the water was already done, and the wheel existed, so the only expense incurred in installing the electric light consisted in arranging suitable gear and erecting countershafting for obtaining the necessary high speed for the dynamos.

These are two in number, each of 120 ampères, 145 volts, and driven off the countershaft already mentioned.

The current is conducted at a potential of from 110 to 140 volts, a distance of about a mile to the accumulators at the house, from whence it is distributed by an ordinary arrangement of regulating switches; part of this main cable is of bare wire supported on ordinary telegraph pattern insulators fixed to wooden posts, and the last 300 yards is of insulated cable underground.

The leakage on the bare portion of the cable in wet or snowy weather must be very high, and the greater part of the ground is liable to be flooded after every heavy rain.

The storage battery consists of a set of 57 K type E.P.S. cells, lately installed, and replacing 55 of L type. As the lights in the house and stables number about 200, on occasions when much light is needed one dynamo has to be run to supplement the storage.

This installation is particularly interesting as being now nine years old, and one of the comparatively few in England where water power is available; the original cost of the plant and apparatus, including wires and fittings, was over £3,000.

It is not difficult to arrive at the total annual cost of production. Repairs and renewals to the dynamos, cables, fittings, not including interest and depreciation, have amounted on the average to 10·8 per cent. per annum on the prime cost; and the battery renewals, including the latest complete renewal of the entire battery, work out to 14·6 per cent.

The labour bill cannot be put at more than 10s. per week, or £26 per annum, as the man in charge is not a skilled electrician, and has also to attend to the various agricultural machinery driven off the same water-wheel which works the dynamos.

The units supplied to the lamps can only be guessed, but it is fair to take them as equal to those required by houses of equal size in London supplied by a public company, which amount to about 12 B.T.U. per lamp per annum, or for the 204 lights, 2,448 total units.

Including interest and depreciation at 8 per cent. on the cost of the generating plant, cables and wires, and adding the average cost of repairs, putting labour at only £26 and petty stores at £10, brings the total annual cost to £569, or 55·7d. per unit, or £2 16s. per lamp per annum. And if looked at as purely "out of pocket" expense, the annual cost has actually averaged £369.

The whole plant and apparatus is considered to be now in good order and condition.

Case II.—Steam Power.

The power plant consists of a compound-wound dynamo, driven by a vertical single cylinder steam engine, the boiler being vertical and tubular, and the storage one set of 53 K-type cells.

The number of lamps fixed is 340, of which 100 are usually burning every day; in addition to the lighting, the current is used to supply a motor about 400 yards away, which actuates a pump, and raises water to a high level reservoir. The current required for this amounts to 2,000 units per annum.

The annual costs are only available for two years, and work out as follows:—

1892.		
	Total cost, including renewals, interest and depreciation as before (8 per cent.)	£478
	Which, assuming again 12 units per lamp fixed, gives 4,080, and plus the pumping, a total of 6,080, at a cost of	17·9d.
	The out of pocket expenses were	£258
1893.		
	Total cost, calculated as before	£406
	The coal bill was fully 25 per cent. lower, owing to the units consumed being less in number; taking them at 10 instead of 12 gives the total units as 5,400, and the cost at (each) ...	18d.
	The out of pocket expenses were	£196

Note.—No spare plant. When all lights are on it is a strain on engine and boiler; they must be run at full load of 80 ampères, and assisted by the cells to give the 150 required; nor is even a spare armature available in case of a breakdown. The plant having only been in operation for two years is in good condition. The cells have lost a good deal of paste, and in future years the repairs to the cells will, no doubt, be costly, and the annual expense will then work out higher.

Case III.—Steam Power.

Here we again have steam power, but of ample size to supply more than the total requirements of the house, without calling upon the battery, also of ample size.

The generative plant consist of a compound engine and shunt-wound dynamo, the latter giving 120 ampères and 140 volts, while the battery consists, or rather consisted, of two sets of 32-L plate cells, capable of 120 ampères discharge. The number of lights fixed is equal to 205 of 8-C.P., which, at ·4 ampères each, requires 82·0 ampères only.

The drawback to the arrangement of power and storage units is that except when charging both sets of batteries in parallel the engine and dynamo can never be worked at more than half-load; it would have been far better to have arranged the generative power capable of supplying 80 ampères as a maximum with 100 volts, which would have been ample for running direct, if required, or for charging one-half of the battery, would have been always running at practically full load with 60 amperes and 140 volts.

The battery being so large could have been economically charged in alternate halves, while, if as arranged, both halves are charged in parallel, the generative plant will stand idle for fully four days a week in summer, or two at least in winter.

It is true that the engineer's time is not required all or every day, and therefore is available for other work on the estate.

The annual costs for three years are as follows:—

1891.		
	Total cost, including interest and depreciation, &c., as before	£445
	Cost per unit, 12 units per lamp for 225 lamps fixed	39·4d.
	Out of pocket expenses were	£148
1892.		
	Total cost	£452
	Cost per unit	40·2d.
	Out of pocket expenses	£155
1893.		
	Total cost	£483
	Cost per unit	43d.
	Out of pocket expenses	£186

The reason of the great difference between the out of pocket expenses and the total cost is accounted for by the fact that at the present time one-half of the battery is on the rubbish heap, and the other half should by rights be there also, and so the author has divided the cost of the cells into three portions, and put down one to each year as strictly speaking due to debit.

But to repeat such figures and facts are tedious and do no good, they are only given in this paper to emphasise what the author has already referred to above as showing how very expensive a lazy or incompetent man in charge will be, and also how the effect of bad arrangement to begin with bears its fruit in due season.

In the first case brought before you this evening, the battery renewals have come out high, as there is no one on the premises who in the least understands treatment of storage cells, and in the last case, a valuable battery by consistent neglect has been irretrievably ruined.

In the second case, only two years' accounts being available, the cost per annum is very reasonable, and not above what a private house installation usually costs.

It evidently is by far the best policy to arrange for the battery to be regularly inspected, not by the contractors who supply, but by the manufacturers, even if the cost of maintenance is as high as 10 per cent. per annum.

Incandescent Lamps.

Owing to the Edison monopoly having now come to an end, incandescent or glow lamps can be purchased in the open market for prices varying from 9d. upwards, but while many of these lamps are undoubtedly as good as the 1892 Edison-Swan lamps, both in efficiency and durability, at the same time a great quantity of a very inferior kind are offered for sale, chiefly by English agents for foreign manufacturers, at a low price calculated to attract the unwary.

The actual energy required by a lamp during a life of from 100 to 800 hours is very nearly the same throughout the time, assuming a constant potential being maintained, but the candle power drops very rapidly with a high efficiency lamp, and more slowly with one of lower efficiency.

The mean candle power during a life of 500 hours for a high efficiency lamp comes out higher than that given by a lamp of lower efficiency, and as cost of renewing is now at the most only 1s. 9d., it will always pay a consumer to use lamps of 3·1 watts per candle, and smash them after 500 hours, rather than lamps of 4 watts per candle, and run them for 1,000 hours.

It is really the question of the cost per mean candle hour.

The trouble in running lamps above the voltage for which they are sold, is that this can only be done by a customer who has his own engine and dynamo, for manufacturers do not usually make, much less stock, 98-volt lamps, and 100 volts is at once the usual pressure available and marked on the lamps; it is therefore simpler to use lamps sold as of high efficiency rather than to over-run.

In conclusion, the author hopes that these few notes on country house electric lighting may prove of interest to the members of the Society of Civil and Mechanical Engineers; they do not pretend to bring forward any novelty, and only treat with the severely economical and business side of the question.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

Discussion on "Parallel Working through Long Lines," by Mr. W. M. Mordey, March 29th, 1894.

(*Continued from page* 411.)

Prof. Ayrton: Suppose they had two alternators, A and B, which had to be synchronised, one of them, if they liked, already attached to the omnibus mains supplying currents, and the other one having to be so attached; then join one terminal of each of the alternators together, not, however, through a long resistance, to which the engineer might naturally object, but take any resistance, 20 megohms if they liked, the very finest pencil line drawn on a piece of ebonite,

and then connect them together by any electrostatic voltmeter they liked, say an electroscope, then as one dynamo was speeded up, the leaves would oscillate backwards and forwards very rapidly, then more and more slowly, and finally when they came together the machine was exactly in step and might be joined on to the omnibus mains. They thus had an arrangement far more dead-beat than a glow lamp; the luminosity remained some time in a glow lamp. The apparatus was cheap—they might make it for a few shillings—and might be as large as they liked; they wanted no scale, no actual calibration.

Mr. W. M. Mordey, in replying to the discussion, said that whilst an engine was going over the dead centre and another engine was taking steam and accelerating a little, there was a tendency to a difference of speed which must be counteracted by very rapid interchange of power between the two machines. That meant that at each stroke of the engine, or, perhaps, twice at each stroke, or oftener if it were more than a single cylinder engine, there was a weakening of the teeth taking place. Now Mr. Kapp would of course acknowledge that he could not possibly regulate for that. Therefore he argued in favour of machines of this type being designed which did not require this regulation, not because they gave a constant strength, a constant parallel for the synchronising effort, but because they complied with what ought to be one of the principal conditions necessary to the good working of central station dynamos; he meant they had a constant E.M.F., or nearly constant. If they took a machine such as Mr. Kapp thought was best and excited it, say for full E.M.F., with no load, and then suddenly switched the load on, the volts would go right away down. The problem they had to face in electricity stations was simply that of variation of E.M.F., and variation of E.M.F. was very much more difficult to avoid in machines of one type than in machines of the other. They might have other advantages. Of course there was no side so good that the other was all ill. Still, these were some considerations that in his view governed the way in which apparatus of this type should be designed. If it were true that machines that had the qualities that Mr. Kapp suggested, they had bad qualities which might be set against those bad qualities in the other type. He said at any rate they ought to start with this type. It was what they must arrive at some day, and therefore they should start with the thing they wanted finally, that was, good regulation, and if they could not find it in combination with the other qualities at present, it was only because knowledge was deficient; they wanted the advantages of both without the evils of either. He quite agreed with Mr. Kapp that there ought to be a margin of power, but he did not think that margin of power ought to be obtained by the use of devices which prevented machines from doing work, and taking care of themselves not by their margin, but by their inability to deal with the work that is put on them. Prof. Thompson mentioned the question of parallel working with a common steam supply. He read a paper a year or two ago, and he thought he pointed out that when a lot of machines were working together, they were practically one machine, and they were obliged to be driven at one speed. It was, on the face of it, wrong to have them governed individually by speed governors; the speed governors could not, of course, govern if the speed remained constant, and the speed must remain constant if the machines were kept together and run at one constant speed. Theoretically, the right thing was to let the steam supply be governed by one governor or by hand, and throttled in such a way as to keep the speed constant for the varying loads. He dared say engineers would have objections to raise on the score of efficiency of steam consumption to that proposal; but, so far as it went, it seemed to be sound enough. Another way which he suggested was that there should be dynamometric governors, and not speed governors, and the speed governors should be used simply for preventing injury in case of breaking connection, or a thing used a good deal in the North, and called an electric engine stopper. This turned steam into a little auxiliary cylinder, and turned off the steam from the stop valve. Prof. Ayrton had raised a point as to static synchronisers, and he said the idea had probably occurred to others. He had no doubt it had. It occurred to him some two years ago, and he made some rough experiments. They did not amount to much. The apparatus used was not very satisfactory, but they showed that static instruments could be used quite well. Voltmeters of the simple electroscope type could be used quite well as synchronisers.

AUSTRALIAN ELECTRICAL NEWS.

[FROM OUR OWN CORRESPONDENT.]

The contract for a very important electric light and power station in a populous mining centre has just been secured by the Crompton Electric Supply Company of Australia. The Hillgrove and Armidale Water Power Company obtained, some time ago, the right of using the water-power available at the Giugra River Falls, a distance of about five miles from Hillgrove; and also engineered the necessary Bill through Parliament, but, owing principally to financial reasons, have been unable until now to go through with their undertaking. Prof. Threlfall, of the Sydney University, having reported favourably on the scheme, the Crompton Company were approached and submitted a scheme for carrying out the work on favourable terms, with regard to price, for the electrical work, the contract for the hydraulic plant being entrusted to Mr. W. H. Palmer, of Melbourne, well-known in connection with the various schemes of the Australian Rights Purchase Association.

The scheme comprises the supply of power to the various gold mines in the Hillgrove district for working stampers and concentrators, the well-known Baker's Creek mine being in this district; also to supply current for lighting in the towns of Armidale and Hillgrove; the power plant and lighting plant to be virtually separate. The power distribution is to be effected by the high tension three-wire system, with continuous currents, using 1,500 volts; the lighting plant being composed of the new 2,000-volt Crompton alternators, whose performances will be watched with considerable interest, as the word alternator in connection with the name Crompton sounds incongruous.

About 770 H.P. is available at the falls with a 500 feet drop, consequently Pelton wheels are to be used, at an estimated efficiency of 75 per cent., giving 580 H.P., available for driving the machines. The Crompton Company have guaranteed a 93·5 per cent. efficiency for the generators, a 7·2 per cent. loss in the mains and a 93·7 efficiency in the motors at full load, or a total efficiency of 60 per cent. from theoretical water power to mechanical power delivered at the mines.

Two 158-unit Crompton continuous current generators are to be used, with one reserve, for power, and two 40-unit alternators for lighting. It is estimated that at least 250 H.P. will be taken up at once for driving stampers and concentrators at the various mines, a condition being made that the speed of these shall not vary more than 2 or 3 per cent under any circumstances.

The latest development at Launceston is that the tenders, together with Mr. K. L. Murray's report, have been referred to Prof. Kernot, of the Melbourne University. The case has aroused widespread interest in Launceston, the local papers being flooded with letters on the subject signed "Indignant Ratepayer," "A Burgess of the City," &c., some of which, by-the-bye, bear marks of having being inspired, if not actually written, by one or two of the belligerents. The citizens of Launceston have, in consequence of this, become so impregnated with electrical matters that they are actually making a stir with regard to the adoption of an electric system for their tramways. Possibly the fact that the sister city of Hobart has already introduced the system may have also had a part in awakening them to the advantages of this system of traction. The Hobart trams seem to be running very successfully, having carried 400,000 passengers in the first three months of working, an average, roughly, of 4,300 per day, the average takings being £49 per day, and expenses £42 per day, a clear profit of £7 per day or over £2,500 per annum, which should be sufficient, if it keeps up, to pay a handsome dividend on the capital expended.

A syndicate has been formed for obtaining the necessary municipal and Parliamentary powers for the lighting of Ballaarat, a large mining township in Victoria, the oldest and largest town, in fact, in Victoria, with the exception, of course, of Melbourne. It is understood that the syndicate mean real business, and already representatives of the various big electric lighting companies are on the track, scenting big business.

NEW PATENTS—1894.

6,212. "Improvements in and relating to conduits for electric railways." M. A. Cattori. Dated March 27th. (*Complete.*)

6,218. "Improvements in or relating to electric keyboards for type-writing and type-setting machines, and the like, also applicable for circuit-closing devices." W. P. Thompson. (Communicated by C. E. Allen, United States.) Dated March 27th. (*Complete.*)

6,241. "A method of depositing and affixing metals by electricity upon a medium which is fastened upon ceramic objects by burning in a kiln." F. A. Rhead and H. G. Coleman. Dated March 28th.

6,248. "Improvements in steam turbines." W. G. Wrench. Dated March 28th.

6,315. "An improved rotary electrical differential controlling device." A. L. Shepard. Dated March 29th.

6,323. "Improvements in or relating to alternating current apparatus or circuits." W. M. Mordey. Dated March 29th.

6,328. "Improvements in electric battery apparatus." J. A. Archer. Dated March 29th.

6,366. "Improvements in electric arc lamps." E. V. Cooke. Dated March 30th.

6,368. "An improved apparatus for tightening telegraph wires and the like." E. A. Hoad and P. Simon. Dated March 30th.

6,388. "Improvements in and relating to fuel economisers." T. Sykes. Dated March 30th.

6,389. "Improvements in making elastic or semi-elastic compositions for insulating and other purposes." R. Hutchison. Dated March 30th.

6,396. "Improvements in and relating to ship's telegraphs." E. J. Griffin and J. Macnab. Dated March 30th.

6,402. "Improvements in electric accumulators." G. E. B. Pritchett, T. W. Pritchett, and A. G. Gold. Dated March 30th.

6,417. "Improvements in connection with switches for electric current transformers." A. Essinger and T. Harden. Dated March 30th.

6,458. "Improvements in dynamo-electric machines." S. Z. de Ferranti. Dated March 31st.

6,482. "Improvements in or relating to multiple telephonic systems and apparatus." P. Moreau and J. Munier. Dated March 31st. (*Complete.*)

6,491. "Improvements in and apparatus for converting electric currents." S. Pitt. (Communicated by A. Blondel & Sautter, Harlé et Cie, France.) Dated March 31st. (*Complete.*)

6,495. "A process for protecting iron pipes from corrosion by passage of electrolysed chloride solutions employed as disinfectants." E. Hermite, E. J. Paterson, and C. F. Cooper. Dated March 31st.

6,497. Improvements in apparatus for electrolysing chloride solutions employed for disinfecting." E. Hermite, E. J. Paterson, and C. F. Cooper. Dated March 31st.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1893.

257. "Improvements in apparatus for insulating electric wires or conductors." R. E. B. Crompton and H. J. Dowsing. Dated January 5th. Relates to the process of insulating wires by attaching them to the surface of plates by means of various enamels which liquefy at a high temperature. 2 claims.

757. "Improvements in platinised electrodes." H. T. Barnett. Dated January 13th. Consists in constructing the conducting support upon which the platinum is deposited with a number of interstices or projections. 3 claims.

758. "Improvements in connection with carbon electrodes." H. T. Barnett. Dated January 13th. Relates to that class of electrode which consists of a number of fine carbon projections situated upon and outstanding from a carbonaceous or metallic conducting support, and consists in constructing the electrodes with guarding portions attached to or formed of the substance of the said conducting support they being so disposed upon and so far outstanding from the same as to prevent the fine projections being damaged under any of the ordinary conditions which they might be subjected to. 2 claims.

813. "Improvements in and connected with the manufacture of electrodes for electric accumulators." C. Pollak. Dated January 13th. Claim:—The method or process of making electrodes for electric accumulators, by stirring carbonate of lead into a paste with caustic alkali, then reducing this paste (after imparting the desired shape to it, by means of suitable supports if necessary, and it has become dry) in an alkaline solution by electrolysis, and finally compressing the porous lead thus formed, to a greater or less degree, immediately after the reducing process, and whilst it is still wet, all substantially as and for the purposes set forth.

1,198. "Improvements in multiple carbon arc electric lamps." J. Brockie. Dated January 19th. Claims:—1. The described method of consuming two pairs of carbons in an electric arc lamp by giving one of each pair a reciprocating movement at intervals, so that the two pairs are consumed by stages alternately. 2. For giving reciprocating movement, such as is above referred to, to the carbons of an electric arc lamp, the combination of the carbon holders, the rocking lever and undulating groove, substantially as described.

1,951. "An improvement or improvements in the arms used for supporting insulators on telegraph poles." T. G. Marsh. Dated January 28th. Claim:—The improvement or improvements in the arms used for supporting insulators on telegraph poles described and illustrated; that is to say, making metallic tubular arms, for the purpose described, flat sided or nearly flat sided through the whole or through a portion of their lengths, preferably at their middles, so that the said arms can be readily fitted and fastened in the ordinary slots of telegraph poles, substantially as described and illustrated.

2,129. "A method and means for producing mica rings or discs, suitable principally for insulating purposes." R. Haddan. (A communication from abroad by C. W. Jefferson, of new York.) Dated January 31st. Consists in building a mica sheet by cementing together laminæ of mica scales with overlapping edges, compressing the sheet into the desired form while the cement is wet, drying the cement by evaporating the solvent thereof, and finally chilling the moulded mica sheet while under compression. 2 claims.

2,703. "Improvements in high tension electrical fuses." D. Bates. Dated February 7th. The inventor constructs a high tension electrical fuse of a fuse wire or assemblage of wires led through a comparatively long passage formed through a block of incombustible non-conducting material, such, for example, as plaster of Paris, or glass or porcelain. 1 claim.

3,488. "Improvements in telephones." Sir C. S. Forbes. Dated February 16th. A horse-shoe or bent steel permanent magnet is forged so that the two extremities or poles, take the form of rings. These are bored out, screwed and fitted with two tympans which are held in position by ebonite or equivalent insulating rings. Between the two poles formed as described is secured a brass or other ring perforated and formed or fitted with an ear piece, trumpet, or trumpets, one of which (when two are employed) may, if desired, be used as a mouth piece, or the instrument may be fitted with a cone shaped trumpet or sound director for loud speaking effects. The brass ring is preferably forked or otherwise so formed as to permit it to carry a horse-shoe or ring-shaped permanent magnet having preferably adjustable soft iron pole pieces which carry inducing bobbins, connecting line and earth. 4 claims.

5,084. "An improved method for fastening electrical conductors, wires, cables, and the like in wood casings by means of adjustable clips or clamps." E. C. Day. Dated March 9th. Consists of an adjustable clip or clamp made of a piece of sheet-steel or other suitable material, about 6 inches long by 1 inch wide, having one end bent up at right angles, the inside face of which end is marked after the manner of a file, on the other end is applied a sliding or adjustable piece, having a set screw to fix it at any desired part of the strip of sheet-steel, this sliding or adjustable piece is also provided with a thumb-screw for the purpose of fastening the clip or clamp on to the casing during the operation of fixing up the cover, and thereby saving a lot of time and annoyance, compared with the present method of fixing up temporary pieces of wood. 1 claim.

10,765. "Improvements in secondary voltaic batteries." E. J. Clubbe and A. W. Southey. Dated June 1st. The negative element consists of a pasty mass of peroxide of lead resting on the bottom of a cell or container of dish or tray form, the said electrode being provided with a conducting plate of lead or an alloy of this metal coated with gold or platinum to prevent oxidation and embedded in, and wholly covered by, the pasty mass except a narrow strip, which serves as a contact piece and is bent so as to pass out of the cell. The tray is of a depth to receive the pasty mass and the positive element, consisting of a plate of spongy lead, is supported horizontally above the positive electrode on suitable insulating supports, and also provided with a similar contact piece. 2 claims.

15,519. "Improvements in electric engines." R. W. Barker. (Communicated from abroad by The Lawrence Electric Company, of New York City.) Dated August 15th. Has for its objects, amongst others, first to provide a machine which is capable of propulsion without the use of gears, &c.; and second, to provide means whereby the mechanism may be started, stopped, and reversed by a single lever. 7 claims.

17,658. "Improvements in current conveyors for electric railways." R. W. Barker. (Communicated from abroad by the Lawrence Electric Company, of New York.) Dated September 19th. Pertains to the means employed for conveying the current from an electric wire to a current distributor connected with propelling apparatus, and its object is to provide a contact or conducting plate formed in two parts, held together within suitable insulation by an outer casing, whereby should said outer casing become worn through, the lower part of the contact plate will fall away, and danger of the current becoming grounded will be avoided. The invention also comprises means for maintaining a perfect connection between the wheels of the contact plate and the electric wire. 3 claims.

18,066. "Improvements in and appertaining to adjustable supporters for electric lamps and other objects or articles." W. R. Lake. (Communicated from abroad by O. C. White, of America.) Dated September 26th. Relates to apparatus for supporting objects such as lamps, lenses, shades, mirrors or display articles, especially incandescent electric lamps in factories, workshops and other situations, where it is desirable to have the object held in a variety of different positions, or in any convenient relation to the work; the intent of this invention being to provide a supporter capable of extensive range and adjustment; to render the same self-sustaining at position without manipulation of fastenings, and adapted for protecting the circuit wires. Also, to provide attaching and connecting joints, of the construction specified, for sustaining the rods or tubes supporting the lamp or other object, and affording the various adjustments. 6 claims.

18,170. "Improvements in electrical contacts." J. S. Raworth. Dated September 27th. An electric contact, according to this invention, is made in one piece of metal, with spring tongues and contact pieces so formed and arranged, that the contact surfaces when forced apart by the insertion between them of a plug or other detachable contact, will, within certain limits, move practically parallel with each other, so that they will retain their original parallelism or angularity relatively to each other under varying degrees of pressure, thus ensuring an even bearing over the whole of the contact surfaces. 2 claims.

18,482. "Means for determining the presence and intensity of atmospheric electricity." J. Opperman. Dated October 3rd. Consists in establishing an electrode—a collector or accumulator—at some relatively elevated position; connecting therewith a suitable insulated electrical conductor, which furnishes an efficient pathway for the electrical charge, as collected at the electrode, therefrom to the earth; and in interposing in the length of the said conductor, at some convenient point, a suitable galvanometer, either indicating or recording, for, at all times, measuring the current flowing therethrough. 1 claim.

18,894. "Improvements in standards of electromotive force." A. Muirhead and J. A. L. Dearlove. Dated October 9th. Claims:—1. In standard cells, the use, as the negative electrode of the combination, of amalgams of cadmium cast in the shape of a rod strengthened by means of a length of amalgamated platinum wire either straight or wound in a spiral and by a glass or equivalent tube, substantially as set forth. 2. The combination, in standard cells, of amalgamated platinum and an amalgam of cadmium of definite composition with a saturated solution of pure mercurous sulphate in saturated solution of cadmium sulphate, respectively as set forth.

18,945. "Improvements in compositions for use in telephonic transmitter circuits, and in the process employed in their production." A. G. Brookes. (A communication from abroad by A. C. Cousens, of America.) Dated October 10th. Relates to the use of titanium in chemical combination with other elements, preferably as an alloy, or with nitrogen, forming nitrides of titanium, or combined with oxygen to form the sesqui-oxide, Ti_2O_3, or in combination with nitrogen and cyanogen, or mixtures of said chemical compounds. 9 claims.

19,024. "Improvements in trolley supports for electric railways." J. M. Andersen. Dated October 10th. Has for its object to provide a simple and efficient mechanism, which, when mounted upon a car, projects but a substantially short distance above the roof of the car, and which is so constructed as to enable the trolley pole to be brought near to and substantially parallel with the roof of the car. 4 claims.

19,127. "Improvements in printing telegraph systems." S. R. Linville and L. F. Hettmansperger. Dated October 11th. Relates more particularly to circuits and mechanical and electrical devices controlled through lines connecting two subscribers' instruments by type-wheel and printing circuits in parallel or multiple arc to earth from one electrode of an electric generator having the other electrode thereof connected to earth. 39 claims.